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Stennis Space Center, MS 39529-5004

NRL/MR/7322--95-7594

Coastal Scene Description: Interim Status Report

Portia J. Harris
George W. Heburn

Ocean Dynamics and Prediction Branch
Oceanography Division

June 16, 1995

JGK

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Portia J. Harris and George W. Heburn

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Naval Research Laboratory
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Stennis Space Center, MS 39529-5004

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13. ABSTRACT *(Maximum 200 words)*

The Coastal Scene Description Project, an exploratory development (6.2) effort, integrates data assimilation/fusion, Expert Systems, visualization techniques and feature models to create an accurate three-dimensional estimation of coastal environments. This interim status report documents FY94 accomplishments and current progress on the FY95 wrap-up. It references team contributions, interagency collaborations, capability demonstrations, feature models, data integration/visualization techniques, presentations and publications. The next milestone is a mission-driven proof-of-concept demonstration on a single platform in a specific testbed area. The demonstration results and FY95 wrap-up are forthcoming in a FY95 wrap-up report.

14. SUBJECT TERMS

amphibious warfare, expert systems, visualization techniques, feature models, data integration, Geographical Information System, fog, upwelling

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The missing pages (4, 5, 7, 8, 9, 12, 13 & 14) in this report are deliberate missing per authors, Portia J.Harris and George W. Heburn, who wrote the report.

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Coastal Scene Description: Interim Status Report

Introduction

The major objective of the Coastal Scene Description (CSD) project is to increase effectiveness and performance across all warfare scenarios using a common tactical display to characterize and visualize the state of the environment. The approach to this objective integrates emerging technologies to create very high resolution visualizations that provide useful environmental information to tactical decision makers. These emerging technologies include data assimilation/fusion, Geographical Information System techniques, Expert Systems, and visualization schemes that resolve data integration conflicts and reasoning under uncertainty issues. A brief description of each task and the responsible laboratory follows.

1) Data Analysis, Feature Models, and Data Fusion
Harvard University/Division of Applied Sciences
(HU/DAS)
Rutgers University/Institute of Marine and Coastal Sciences
(RU/IMCS)

   Acquire, assimilate, fuse, and assess mission area datum and utilize feature models to analyze the impact of environmental (atmospheric, meteorologic, oceanographic) processes on tactical decisions

2) Ocean Expert System
Johns Hopkins University/Applied Physics Laboratory
(JHU/APL)

   Investigate Expert Systems reasoning schemes to formulate data representation and data interpretation methods for tactical decision knowledge bases

3) Shore-zone Resolution System
Naval Research Laboratory/Stennis Space Center
Marine Geosciences Division
(NRL/SSC/MGD)

Identify methods to integrate multi-source/multi-type datum and resolve data variabilities to provide high fidelity atmospheric, meteorologic, oceanographic, and digital mapping, charting and geodetic data

4) Tactical Environmental Information System (TEIS)
Applied Physics Laboratory/University of Washington
(APL/UW)

Explore database management schema and visualization tools to display high fidelity informative visualizations

5) Project Management, System Integration, and Proof-of-Concept Demonstration
Naval Research Laboratory/Stennis Space Center
Oceanography Division
(NRL/SSC/OD)

Provide overall project direction and focus to integrate project tasks on a single platform at NRL/SSC that simulates warfare scenarios using very high resolution environmental data

Appendix A gives the project overview and details of the approach, objective, deliverable(s), FY 94/95 Funding Profile, FY 94 Accomplishments, and FY 95 Plans for each task.

FY 94 Focus and Accomplishments

In its initial phase, this project had four stand alone tasks. In FY 94, the project focus was to integrate all tasks to demonstrate an on-scene description for a specific mission and testbed area. The mission selections were Amphibious Warfare, Mine Countermeasures, and Special Warfare in the Straits of Sicily, Yellow Sea, Sea of Japan and other Navy interest areas.

Since there is limited high resolution environmental data in these areas, the proof-of-concept demonstration is a laboratory simulation of an Amphibious Warfare Scenario in the Middle Atlantic Bight (MAB). The MAB was selected because of its process rich/data rich features, and analogy to Navy interest areas, such as the Adriatic Sea, Sea of Japan, Yellow Sea, Persian Gulf, and Gulf of Oman. Its colocations with Navy/Marine Corps training and doctrine commands provides a mechanism to leverage other funded programs, and acquire data and system performance metrics from ongoing field exercises. Collaborations with representatives from the Defense Mapping Agency, Littoral Warfare Training Center (LWTC)/Camp LeJuene, Synthetic Theater of War (STOW) 1997, and Naval Oceanographic Office are ongoing through MiniWorkshops, site visits, system demonstrations, presentations, and publications. Agendas, attendance lists, and reference documents are attached in Appendix A through Appendix F.

The FY 94 Accomplishments were Amphibious Warfare (AMW) Critical Factor Analysis, Data Integration, Visualization Scheme Development, and a Concept Development and Demonstration Testbed Area Document.

FY 95 Plans and Current Progress

The proof-of-concept demonstration is a data-driven milestone because the requirements for very high resolution data characterization and visualization in coastal areas. High resolution data is sparse and often times non-existent in coastal areas. Field measurements are ongoing and valid data sets are now accessible on an as needed basis. In many cases, developers, modelers, and scientists must rely on interpolation schemes, mixed resolution smoothing, or limited area coverage data sets to conduct research, development, test and evaluation. In order to meet the project objective, New Jersey Coast observations of 4 AUG 94 are used to characterize and visualize the impact of fog and upwelling predictions on Amphibious Assault.

The observations are AVHRR data from NOAA platforms 11 and 12 (every four hours) and continuous current and wind measurements from 12m depth current meters and wind sensors located 10m above the Rutgers Marine Field Station tower. The geographical area coordinates are 39:14:21N, 74:24:32W.

The current progress is based on several developmental tasks that are at or near completion.

1) Testbed Area Selection
2) High Resolution Data Source Identification
3) Warfare Area and Platform Host Designation
4) Data Management & Importation Testing

5) SceneObject Library Development

6) Upwelling/Fog Processes

7) Regional Atmospheric Modeling System Tests

8) MAB Multiscale Feature Model For Shelf, Slope and Gulf Stream and Meander Region

9) Multiscale Resolution Nowcasts

10) Two-Way Nesting: Embedded Grid To Largest Grid

11) SHORES Version 1 Development Using ARC/INFO & MOSAIC

12) Import/Export Data Exchange Functions

13) MOSAIC Documentation & Demonstration Development

14) Error Analysis Deconfliction Tool Data Checking Ops

15) Multi-Level Data Integration

Future Directions

In FY 96 the project focus is very high resolution 4D currents, tides, and waves in coastal environments. Data assimilation/fusion, modeling & simulation, and system performance metrics are in review and will be adapted to very high resolution environmental applications that represent coupled interactions and generate surface nowcasts and forecasts. The two specific projects are **Coastal Simulation and Coastal Ocean Currents** with a data coupling to **Coastal Ocean Sensing and Data Fusion.**

Collaboration with the Littoral Environment Optics, NOMP, TOSL/TOWAN, and other funded programs leverages useful data and technology to evaluate and improve Navy system performance.

APPENDIX A

PROJECT DESCRIPTION

CSD OVERVIEW

CSD FUNCTIONAL DIAGRAM

FUNDING PROFILE

CSD FY 94 ACCOMPLISHMENTS & FY 95 PLANS

TASK DESCRIPTIONS
(Graphics, Objective, Approach,Deliverable)
(Funding, FY 94 Accomplishments, FY 95 Plans)

1) **Data Analysis, Feature Models, & Data Fusion**
   Harvard University/Division of Applied Sciences

2) **Data Analysis, Feature Models, & Data Fusion**
   Rutgers University/Institute For Coastal & Marine Sciences

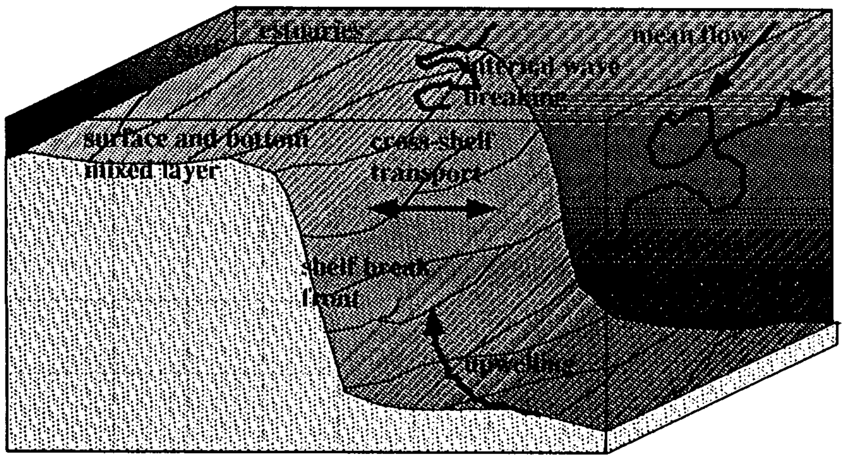
3) **Ocean Expert System**
   Johns Hopkins University/Applied Physics Laboratory

4) **Shorezone Resolution System**
   Naval Research Laboratory/Marine Geosciences Division

5) **Tactical Environmental Information System**
   Applied Physics Laboratory/University of Washington

Coastal Scene Description Overview

NRL Code 7320



Objective

- Using all sources of information, measurements (in-situ and remote), climatology, and models (feature and numerical), create accurate "gridded" quantitative 3D estimation of the environment in the coastal area.
- Create "useful" , informative visualizations of the state of the environment for tactical decision makers.
- Demonstrate coastal scene descriptions for Amphibious, MCM, and SpecOps scenarios.

Approach

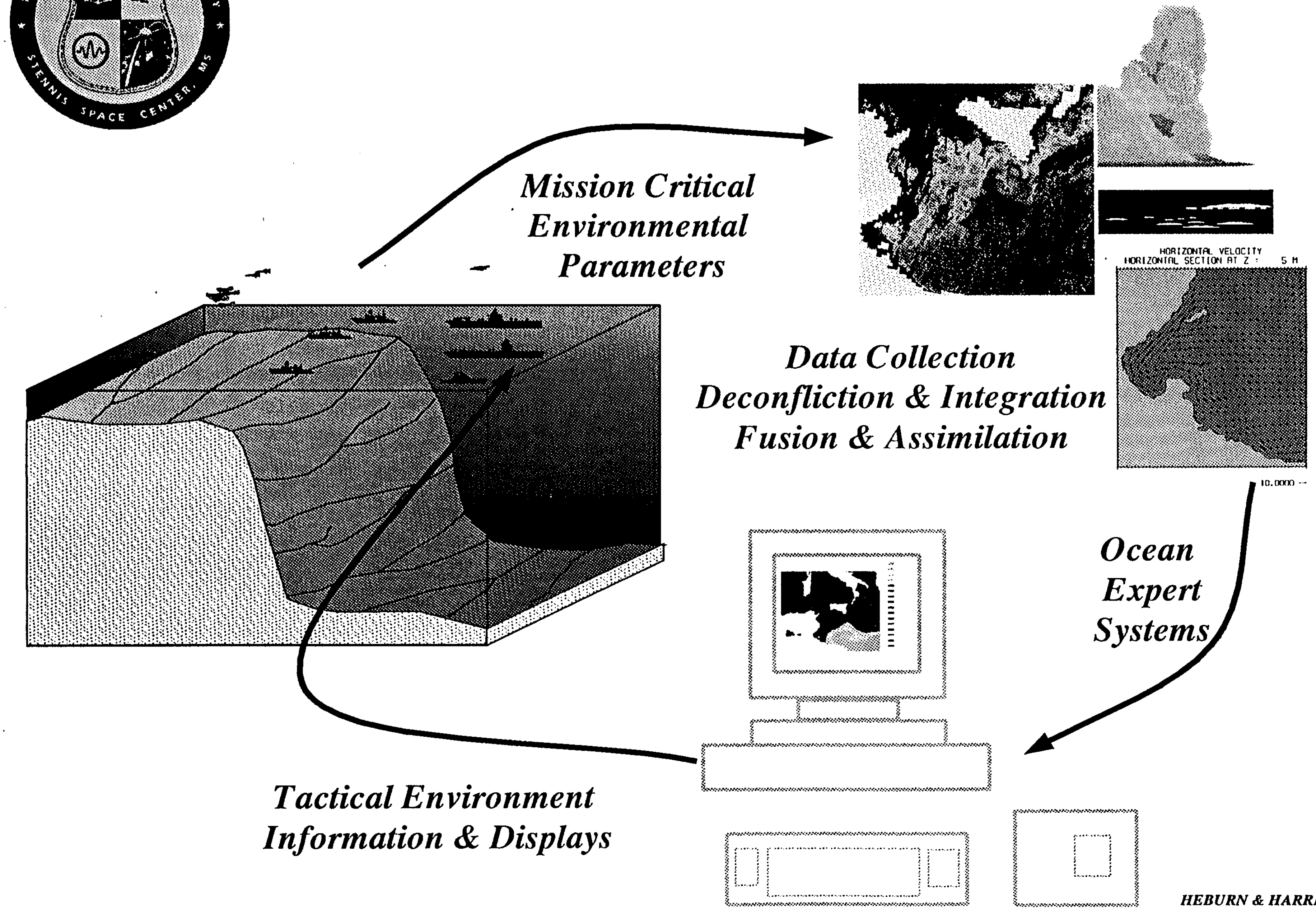
- Acquire environmental datum from remote imagery, water measurements, climatology, models, infrared, and optical sources to analyze, assimilate, fuse, and execute using littoral area feature models.
- Identify a proof-of-concept testbed area for simulations and demonstrations.
- Utilize Expert Systems Technology and database management schema to interpret and represent environmental datum for on-scene visualizations.
- Integrate feature model results and visualizations to provide high fidelity environmental information for coastal scene descriptions and on-scene data transfer.
- Conduct Proof-of-Concept Demonstrations
  - FY95 Amphibious
  - FY96 MCM
  - FY97 SpecOps

Final Product

- On-Scene Coastal Scene Description Capability
- On-Scene High Resolution Visualizations
- Increased Tactical Decision Aid Environmental Support

HEBURN & HARRIS, 1994

Coastal Scene Description Functional Diagram



HEBURN & HARRIS, 1994

Funding Profile ($K)

Years	Base	Other	Total
FY94	950	630	1580
FY95	950	610	1560

Coastal Scene Description FY 94 Accomplishments

- Completed Comparative Mission Area Assessments for the Middle Atlantic Bight (MAB), Yellow Sea, and Sea of Japan

- Examined MAB Oceanographic and Meteorological Processes and First Generation and Advanced Scientific Visualization Tools

- Implemented New Data Analysis Methods and On-Scene Data Interpolation Techniques

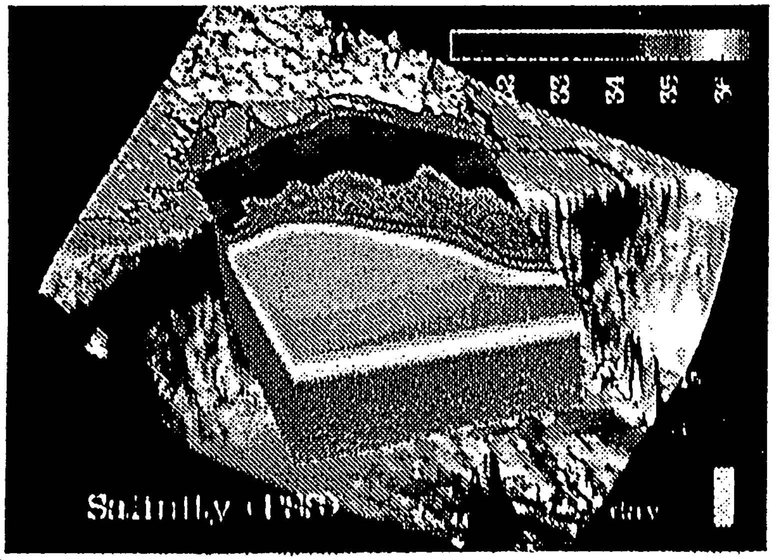
- Completed Critical Factors Analysis for Amphibious Warfare Scenario

- Organized, Integrated, and Registered Littoral Warfare Training Center and MAB Data Resources

Coastal Scene Description FY 95 Plans

- Integrate subtasks on single platform at NRL/SSC
- Demonstrate Proof-of-Concept for Amphibious Warfare Scenario
- Document Proof-of-Concept Results
- Host Project Review Meeting

COASTAL SCENE DESCRIPTION
Data Analysis, Feature Models and Data Fusion



Objective
The fusion of datastreams, climatology, feature and statistical models to generate accurate nowcasts of the coastal multiscale environment.

Approach
Apply methodology to combine feature models, *in situ* and remote observations to initialize and assimilate in the dynamical models. Establish sensitivity and robustness of the method in each application.

Deliverables
Nowcasts in selected areas of the MAB and Sicily Straits regions for the use of CSD participants.

PRINT SIZE

A

COASTAL SCENE DESCRIPTION
Data Analysis, Feature Models and Data Fusion

FY 94 Funding
$ 105,000

FY 95 Proposed Funding
$ 110,000

Accomplishments

Implementation of multiscale feature models for the shelf-break and Gulf Stream System.

Fusion of multiscale feature models and MARMAP datasets.

Plans

Rapid Assessment Cruise in the Sicily Straits.

Generation of nowcasts for the MAB and Straits of Sicily regions.

Coastal Scene Description

Data Analysis, Feature Model and Data Fusion

Mid Atlantic Bight

South Atlantic Bight

Objective

Analysis and fusion of oceanographic data and models for 3-D coastal scene description in the Middle and South Atlantic Bights.

Approach

*Collect relevant oceanographic and meteorological data.

*Acquire or construct accurate coastline/bathymetry database.

*Compile datasets in a Geographic Information System (GIS).

*Summarize events and trends of interest to CSD participants.

*Distribute required datasets to other CSD participants.

Deliverables

*MAB and SAB oceanographic/meteorological datasets.

*Accurate coastlines and bathymetry.

*Geographic Information System.

*Event summaries.

Coastal Scene Description

Data Analysis, Feature Model and Data Fusion

FY 94 Funding

$0

FY 95 Proposed Funding

$90,000

Accomplishments

New Start

Plans

*Acquire relevant oceanographic and meteorological data from:

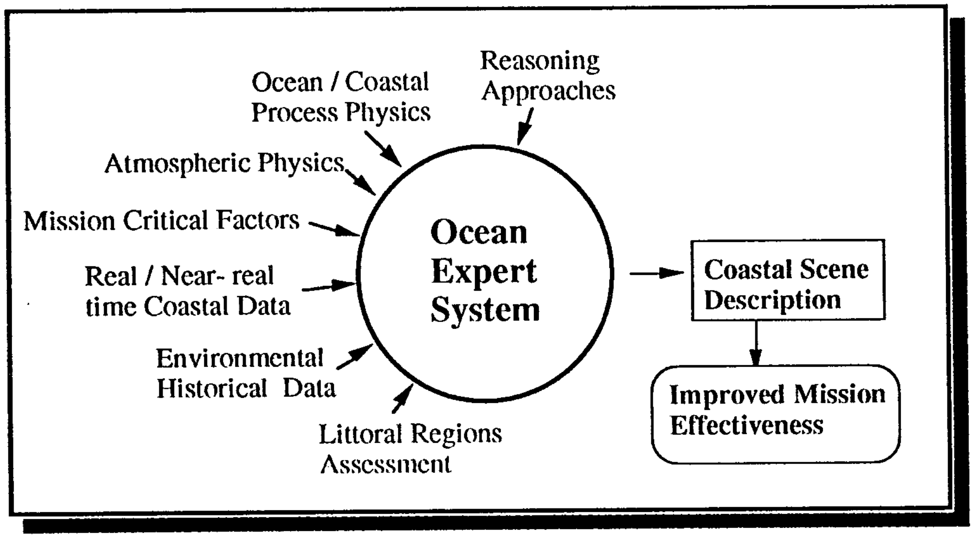
- Rutgers Marine Remote Sensing Lab, New Brunswick, NJ
- Rutgers Longterm Ecosystem Observatory, Tuckerton, NJ
- CERC Field Research Facility, Duck, NC
- LWTC, Camp Lejeune, NC
- NOAA Buoys, C-MAN and Tidal Stations.

*Concentrate on data collection starting in 1993, due to availability of satellite imagery.

*Construct GIS with MAB and SAB subregions.

*Use GIS to develop summary descriptions of important events and trends.

Coastal Scene Description
Ocean Expert System



Approach

- **Use mission to focus attention on coastal environmental critical factors**
- **Represent dominant oceanic and atmospheric processes which determine the critical environmental parameters**
- **Use expert system tools to unite process physics with real-time measurements and historical databases**
- **Focus on tactical decision maker who will use coastal scene description to enhance mission planning and execution**

Objectives

- **Provide mission dependent description of coastal environmental "scene" to enhance tactical decisions and mission effectiveness**
- **Provide the technology to support and implement the coastal scene description**

Deliverables

- **Periodic computer-based demonstrations showing increasing functionality in individual components and integrated system**
  - **-FY94: Reasoning Tools, Envir. Data Bases, Display**
  - **-FY95: Amphibious Assault Process Physics (Upwelling, Fog)**
  - **-FY96: Mine Countermeasures**
- **Reports providing periodic assessments on importance of coastal processes in key foreign littoral regions**
- **Quarterly and Annual Status Reports, Technical Papers**

Coastal Scene Description
Ocean Expert System

FY94 Funding

$336 K

Accomplishments

- Completed critical factors analysis for amphibious assault
- Compared and assessed coastal process reasoning approaches
- Provided a comparative assessment of important oceanographic and meteorological processes in foreign littoral regions
  - Coordinated white paper selecting Mid Atlantic Bight/ Littoral Warfare Training Complex (MAB/LWTC) as focus area for coastal scene description coordination
- Provided in-situ data analysis from navy platform on patrol to examine detection and display of frontal crossings
- Acquired and installed environmental data bases

FY95 Funding

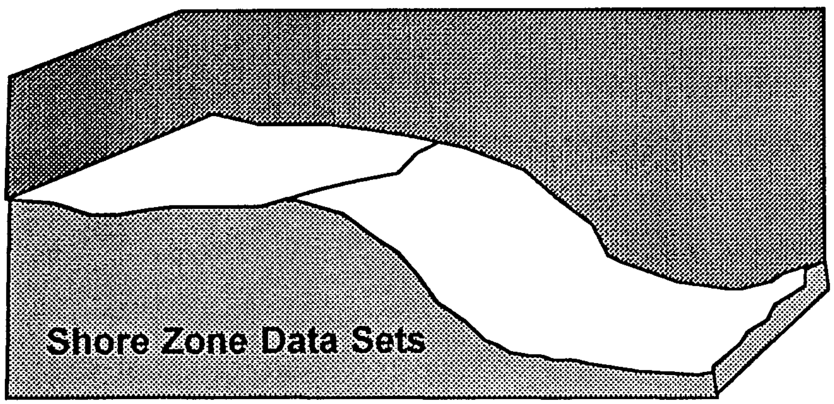
$280 K

Plans

- Focus on amphibious assault and description of coastal upwelling and fog to provide "proof of concept" demonstration
- Develop OES tools and data bases necessary for optimal scene rendering
- Assess importance of analogous processes in foreign littoral regions
- Provide in situ data assessment for TOMS coastal data in Gulf of Mexico as sample of handling real-time measurements from Navy platform

Coastal Scene Description
Shore-zone data REsolution System

SeamlessTopo/Ocean/Atmos. Data Integration



Objective

Provide dMC&G data integration support to CSD

1) Interactive spatial data fusion/integration
2) Error/Conflict Analysis Tools
3) Software Tools for supervised/un-supervised data deconfliction
4) Enhanced data exchange utilities using HDF
5) Provide multi-thematic deconflicted data to MAB Testbed

Approach

- Utilize Public Domain and COTS GIS
- Provide on-line data analysis using GeoBASE and MUSE
- Distribute data as HDF Vsets
- Continue examination of industry standards and current research

Deliverables

- Enhanced SHORES User Interface
- MAB Testbed Data Sets
- Error/Conflict Analysis Utilities
- Deconfliction Tools
- User Documentation

Coastal Scene Description
Shore-zone data REsolution System

FY94 Funding $150,000	*FY95 Proposed Funding $215,000*
Accomplishments	***Plans***
•Provided dMC&G liaison to CSD •Attended program meetings •Identified/Collected/Imported dMC&G data into ARC/INFO •Implemented HDF import/export functions for ARC data •Delivered HDF Structured data to CSD participants •Began Developing SHORES error/conflict analysis tools	•Enhance Data Exchange Process •Modify/enhance error/conflict analysis & deconfliction tools •Implement additional HDF viewing capabilities •Gather/distribute additional dMC&G data for MAB Testbed •Provide data integration support for oceanographic/atmospheric data with dMC&G data

Coastal Scene Description

Tactical Environmental Information System

Objective

Provide working test bed for new technologies that support data assimilation, data fusion and visualizations for improved description of the coastal environment.

Approach

- New object-oriented data management schema
- Implementation of foundation classes for use by CSD
- Application and integration of scientific visualizations to database schema
- Support Proof-of-concept demonstrations

Deliverables and Transitions

- Deliver documented, supported, software libraries for building CSD applications and visualizations
- Deliver object-oriented data management software for supporting persistence
- Provide TEIS software libraries for use in SPP-ADM program and ultimately SIMAS II fleet usage
- Provide data visualizations for NAVO DMARS program

Coastal Scene Description

Tactical Environmental Information System

FY 94 Funding

Expected 400K
Received 336K

FY95 Proposed Funding

Proposed 400K

Accomplishments

- Designed object-oriented persistent data management software and completed evaluation of commercial databases
- Added over 60 new data classes to TEIS libraries and redesigned them to support multiple distributed views
- Developed new software prototypes to testbed TEIS libraries and new visualizations
- Developed distributed processing prototype

Plans 95

- Document and deliver TEIS libraries supporting multiple distributed views to CSD partners and others
- Refine and extend object-oriented data management software
- Extend distributed processing prototype and define a CSD network interface
- Implement data analysis tools
- Assess software requirements for LWTC/STOW 97 and CSD collaborations

APPENDIX B

Tactical Oceanography Simulation Laboratory
Coastal Scene Description
Technical Working Group Meeting

22 MAR 95

AGENDA

ATTENDEES

MEETING NOTES

Tactical Oceanography Simulation Laboratory/ Coastal Scene Description (TOSL/CSD) Technical Working Group Meeting
Naval Research Laboratory
Stennis Space Center, MS 39529
22 March 1995
Agenda

0830 Welcome

0845 CSD Overview

0915 Ocean Expert System

0930 Tactical Environmental Information System

0945 Shorezone Resolution System

1000 Data Analysis, Feature Models, Data Fusion

Harvard University
Rutgers University

1030 Break

1040 TOSL Overview

1100 TOSL Demonstration

1130 Working Lunch

1230 TOSL/CSD Integration Requirements

Network Access
Hardware/Software Support
System Configuration (Memory, Storage, Data Transfer, Hardcopy Output)
Moasic, World Wide Web, HDF Format

Upcoming Events

Preliminary AMW Demo Dry Run 18 - 21 APR

CSD Review & AMW Demonstration 24 MAY 95

Tactical Oceanography Simulation Laboratory/ Coastal Scene Description (TOSL/CSD) Technical Working Group Meeting

Naval Research Laboratory
Stennis Space Center, MS 39529
22 March 1995

Attendees

NAME	EMAIL	PHONE
Arango, Hernan	arango@pacific.harvard.edu	(617) 495-3457
Breckenridge, John	jbreck@dittohd.nrlssc.navy.mil	(601) 688-5224
Crowley, Michael	crowley@caribbean.rutgers.edu	(908) 932-6555 X543
Glenn, Scott	glenn@caribbean.rutgers.edu	(908) 932-6555 X544
Harris, Portia	harris@nrlssc.navy.mil	(601) 688-5787
Heburn, George	heburn@nrlssc.navy.mil	(601) 688-5448
Henderson, Laurel	laurel@ahab.rutgers.edu	(908) 932-6555 X542
Kerr, Keith	keith@apl.washington.edu	(206) 543-1268
Leslie, Wayne	leslie@pacific.harvard.edu	(617) 495-4569
Lozano, Carlos	lozano@pacific.harvard.edu	(617) 495-9807
Mack, Stephen	steve_mack@jhuapl.edu	(301) 953-6478
Miyamoto, Robert	rtm@apl.washington.edu	(206) 543-1303
Robinson, Alan	robinson@pacific.harvard.edu	(617) 495-5192
Scheerer, David	david.scheerer@jhuapl.edu	(301) 953-6000 X8754
Starke, Susan	starke@nrlssc.navy.mil	(601) 688-4090
RP Ralph Perniciaro	Ralph@dittohd.nrlssc.navy.mil	601-688-5560

TOSL/CSD Meeting Notes
22 March 1995

CSD team members and Ms. Susan Starke, TOSL representative, met to discuss using the TOSL platform for the CSD Wrap-Up Demonstration. Dr. George Heburn gave the project overview and each task leader gave a brief description of their needs for the demonstration. Ms. Starke gave a TOSL demo that included an overview of its current capabilities using several data analysis and visualizaion tools. She discussed models, data, and the benefits of TOSL/CSD efforts to generate useful simulation tools.

CSD team members will have access to TOSL Tools and TOWAN Data to ingest CSD tools and data. After much discussion of declining budgets, the body was advised to seek other sources for FY 96 funding. The FY 95 Wrap-Up Project will transition current tools to NRL/SSC, provide documentation, and demonstrate individual task with some integration with other tasks. The demonstration is tentatively scheduled for an internal project review in June.

APPENDIX C

MINIWORKSHOP (APL/UW)
14 FEB 95

AGENDA

ATTENDEES

HANDOUTS

1) A Rapid Assessment Cruise in the Straits of Sicily
2) Middle Atlantic Bight Data Sets
3) Middle Atlantic Bight Summer Trends
4) Amphibious Assault Scene Description Status
5) The Regional Atmospheric Modeling System
6) Meeting Goals
7) The SceneObject Framework Design
8) SHORES: SHOre-zone Data RESolution
9) Tactical Oceanography Simulation Laboratory

Coastal Scene Description MiniWorkshop
Applied Physics Laboratory
University of Washington
14 February 1995
Agenda

FY95 Project Direction/Budget & Funding
George Heburn/Naval Research Laboratory/Stennis Space Center

Status Reports

Data Assimilation, Feature Models,Data Fusion

Rapid Assessment Cruise
Carlos Lozano/Harvard University

Middle Atlantic Bight Data Sets
Laurel Henderson/Rutgers University

Middle Atlantic Bight Summer Trends
Mike Crowley/Rutgers University

Ocean Expert System/Amphibious Assault Scene Description Status
Steve Mack/Johns Hopkins University/Applied Physics Laboratory

Regional Atmospheric Modeling System
Charles Schemm/Johns Hopkins University/Applied Physics Laboratory

Tactical Environmental Information System
Bob Miyamoto/Applied Physics Laboratory/University of Washington

Shorezone Resolution System
John Breckenridge/Naval Research Laboratory/Stennis Space Center

Amphibious Warfare Demonstration
Portia Harris/Naval Research Laboratory/Stennis Space Center

15 MAR Coastal Scene Description/Tactical Oceanography Simulation Laboratory Technical Work Group

17 APR - 21 APR Preliminary Amphibious Warfare Demo Dry Run

This week is a MiniWorkweek for all participants to install, test evaluate and determine where we are in terms of the 24 MAY Coastal Scene Description Review and Amphibious Warfare Demonstration

******* 24 MAY CSD Review & Amphibious Warfare Demonstration *******

14 copies each

Coastal Scene Description MiniWorkshop
Applied Physics Laboratory
University of Washington
14 February 1995

	NAME	EMAIL	PHONE
1	Breckenridge, John	jbreck@dittohd.nrlssc.navy.mil	(601) 688-5224
2	Crowley, Michael	crowley@~~caribbean~~ atlantic.rutgers.edu	(908) 932-6555 X543
3	Harris, Portia	harris@nrlssc.navy.mil	(601) 688-5787
4	Heburn, George	heburn@nrlssc.navy.mil	(601) 688-5448
5	Henderson, Laurel	laurel@ahab.rutgers.edu	908/932-6555 x542
6	Kerr, Keith	keith@apl.washington.edu	(206) 543-1268
7	Lozano, Carlos	lozano@pacific.harvard.edu	(617) 495-9807
8	Mack, Stephen	steve_mack@jhuapl.edu	(301) 953-6478
9	Miyamoto, Robert	rtm@apl.washington.edu	(206) 543-1303
10	Scheerer, David	david.scheerer@jhuapl.edu	(301) 953-6000 x875
11	Schemm, Charles	terry_schemm@jhuapl.edu	(301) 953-6172
12	Perniciaro, Ralph	Ralph@dittohd.nrlssc.navy.mil	(601) 688-5560
13	Kooiman, Bill	billk@apl.washington.edu	(206) 685-3198
14	Mark Stoermer	storm@apl.washington.edu	(206) 685-3198
15	Bill Hess	hess@apl.washington.edu	(206) 543-9193
16	Janet Olsonbaker	janeto@apl.washington.edu	(206) 543-3225

COASTAL SCENE DESCRIPTION

A Rapid Assessment Cruise
in the Straits of Sicily.

MAB: Nested domains.

APL/UW February 14 1995

REAL TIME NOWCASTING AND FORECASTING

R/V Alliance NOV94 Cruise

11-22 November 1994

A.R. Robinson [1], H.G. Arango [1], W.G. Leslie [1]
C.J. Lozano [1], P.J. Haley [1], A. Gangopadhyay [1], N.Q. Sloan [1]

A. Warn-Varnas [2,3], P.-M. Poulain [2], A. Miller [2],
G. Baldasserini-Battistelli [2], M. Zahorodny [2], P. Zanasca [2]

HARVARD UNIVERSITY (1)
Division of Applied Sciences
Department of Earth and Planetary Sciences
Cambridge, Massachusetts

SACLANT Undersea Research Centre (2)
La Spezia, Italia

Present affiliation: NRL Stennis (3)

AIS94 — Scientific Objectives

- Rapid Assessment of multiscale structures

  Mesoscale Features over Large-Scale Region [MS-LR]

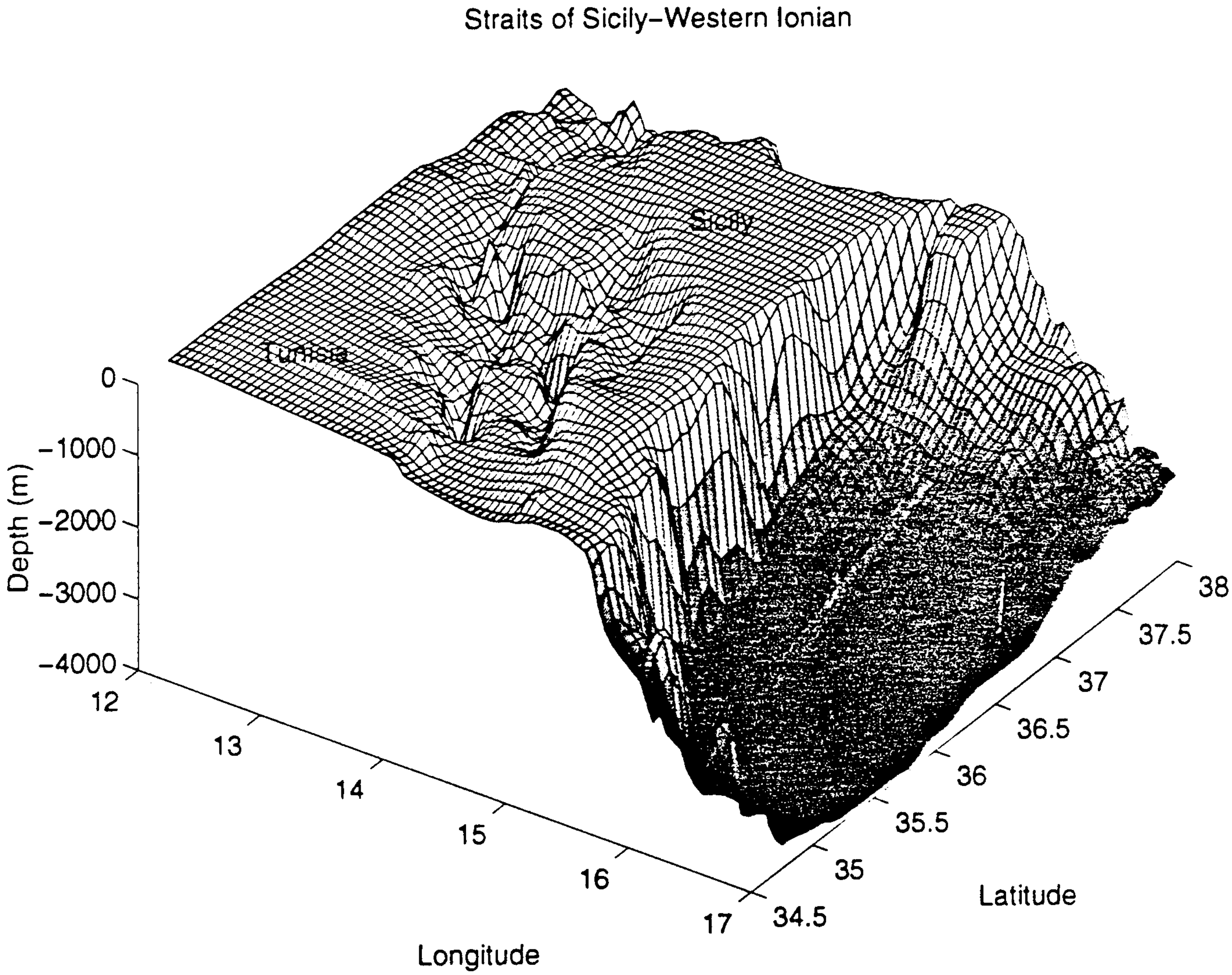
  Sub-mesoscale Features over Mesoscale Region [MS-MR]

- To exercise H O P S in a complicated region: deep / shelf-break / shelf ocean with tall and steep topography

- To demonstrate the real-time nowcasting and short-term forecasting operations by:

  Assimilation of Direct Data Streams in a regional Multi-scale Nested primitive equation model set up with Climatology, Feature models and wind-forcing.

- To study the dynamics of the Atlantic Ionian Stream, its filamented and frontal features and its transition from a flow over the shelf to a flow over deep water



Straits of Sicily-Western Ionian
Sicily
Tunisia
0
-1000
-2000
-3000
-4000
Depth (m)
12
13
14
15
16
17
Longitude
34.5
35
35.5
36
36.5
37
37.5
38
Latitude

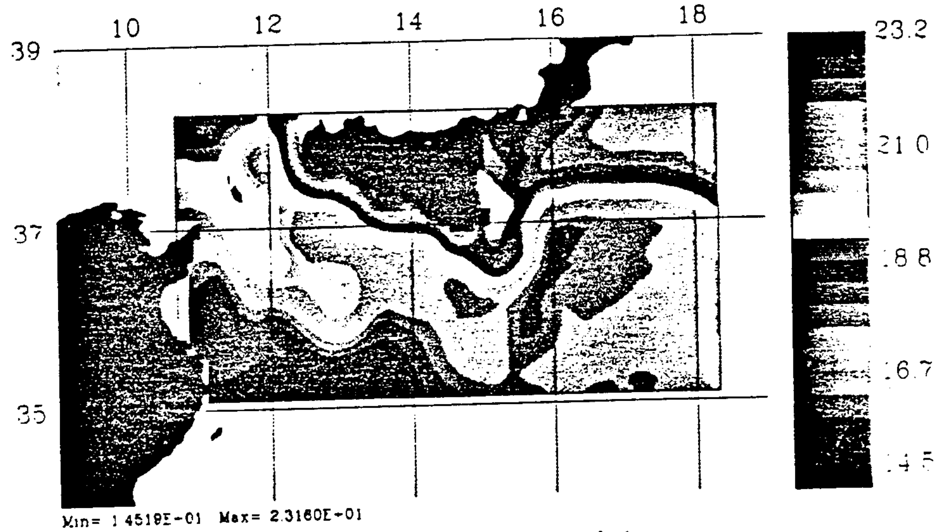
AIS94 CRUISE Approach

- Survey of Mesoscale in Large Region
- Large Domain Initialized via

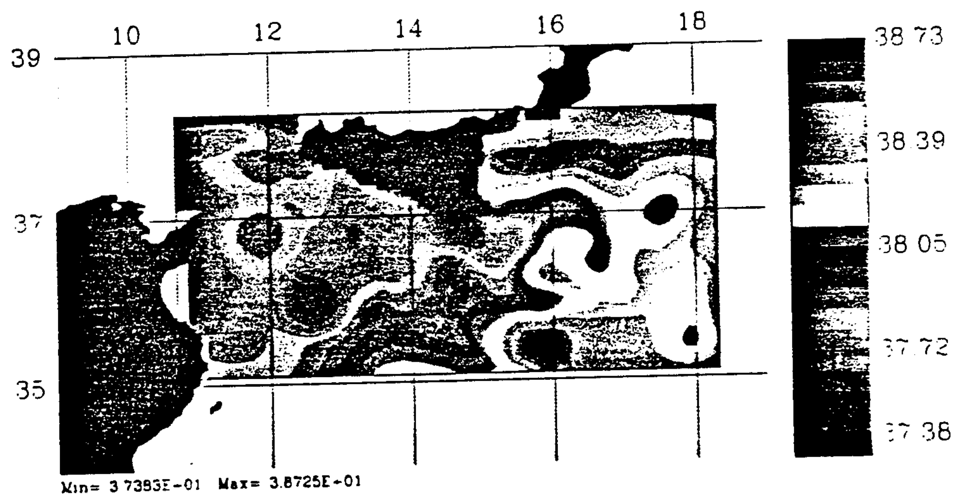
  Climatology and Feature Models
- Assimilation In Nested Domains – Multiscales
- **NOWCASTS and SHORT-TERM FORECASTS**

  obtained by assimilation of

  Direct Data Streams (*In Situ*, Remotely Sensed), and
  Model Simulations



Temperature (deg C) at Level 1



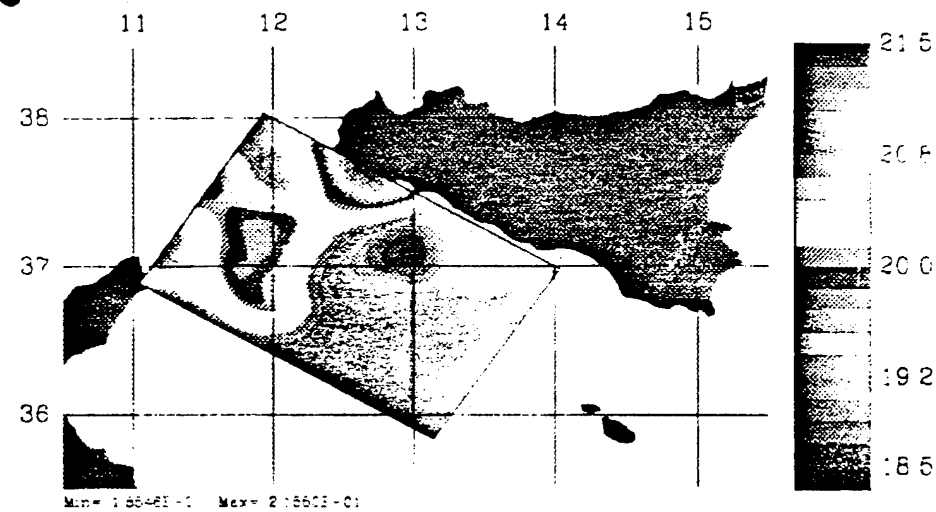
Salinity (PSS) at Level 1

HARVARD / SACLANT

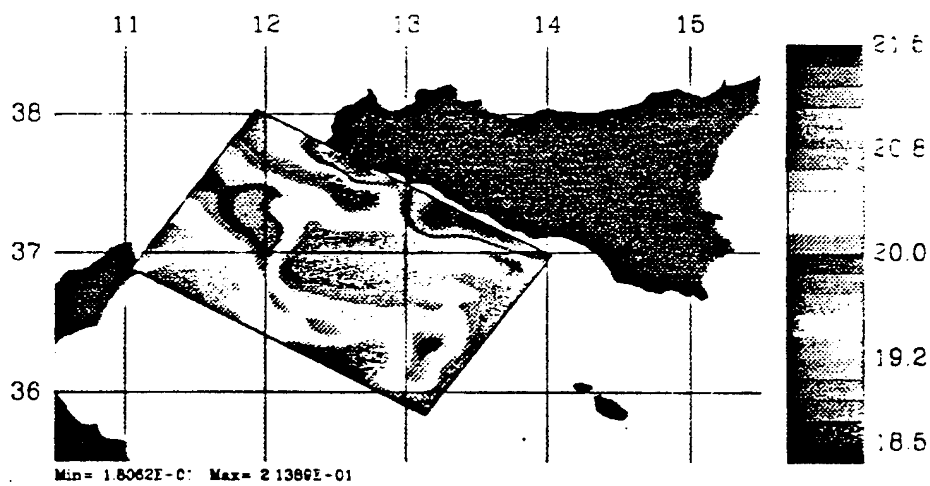
AIS94 R/V Alliance Nowcast/Forecast Simulation (RCNF2C)

Climatology plus Tracks 1-3; Assimilation Tracks 4-6

Temperature at Level 1



Nowcast 13 Nov 1994



4.00 Day Forecast : 17 Nov 1994

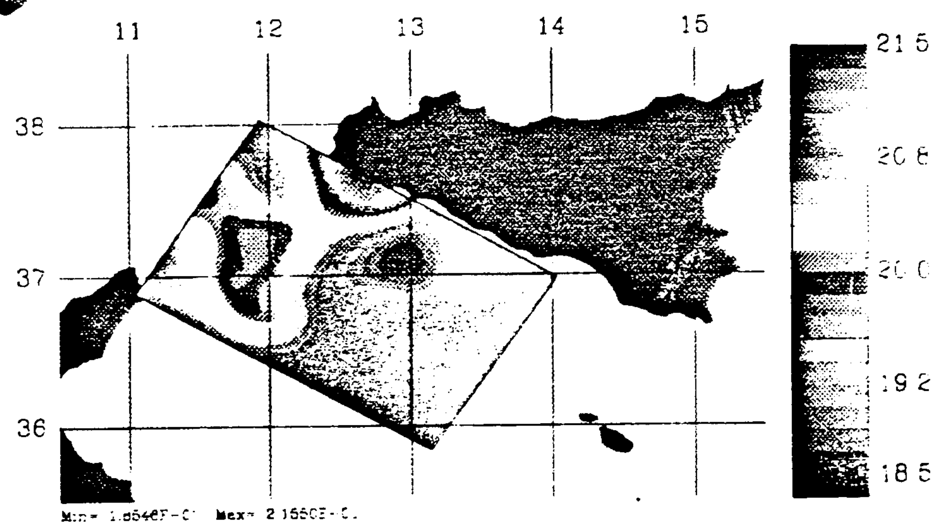
MGA
ARR
Nov 16, 1994

HARVARD / SACLANT

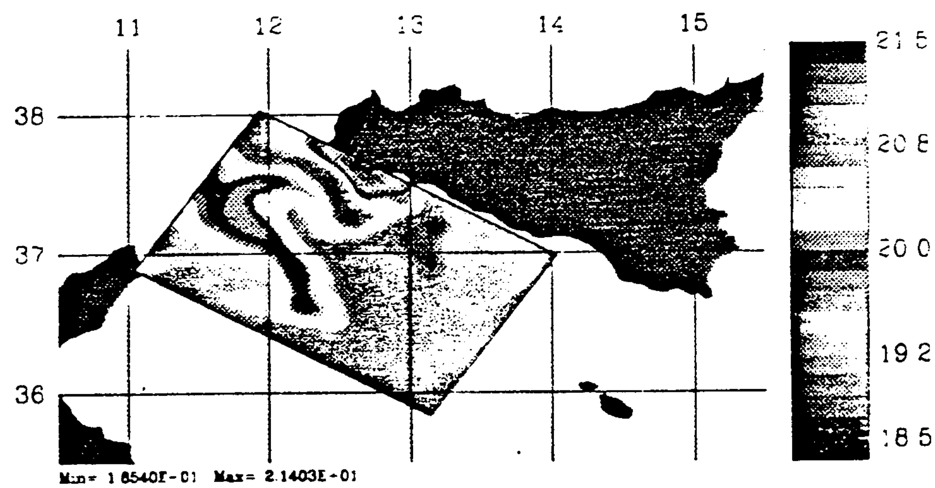
AIS94 R/V Alliance Nowcast/Forecast Simulation (RONF1C)

Climatology plus Tracks 1–3

Temperature at Level 1



Nowcast 13 Nov 1994



4.00 Day Forecast : 17 Nov 1994

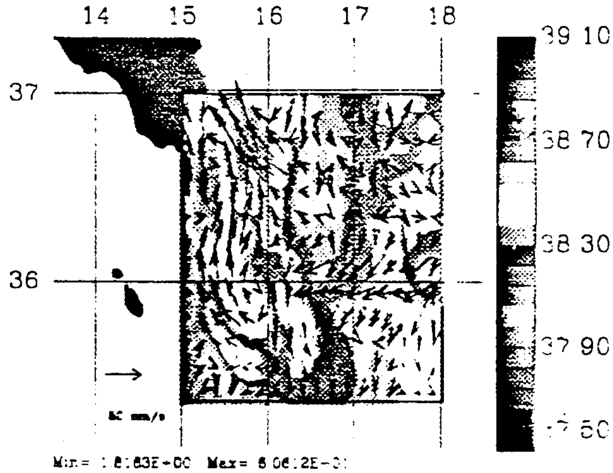
HGA
ARR
Nov 18, 1994

HARVARD / SACLANT

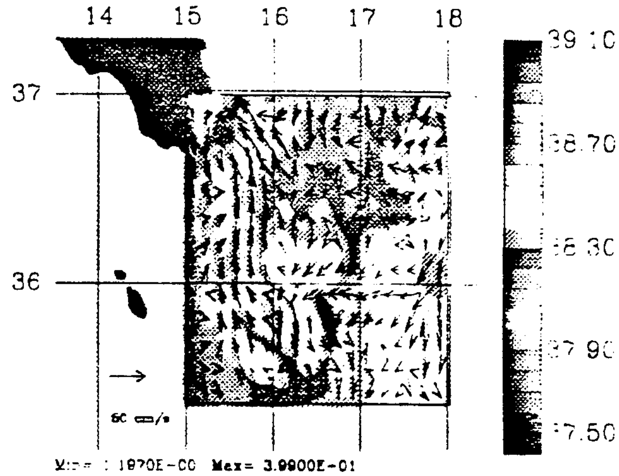
AIS94 R/V Alliance Nowcast/Forecast Simulation (RONF5C)

Climatology plus Tracks 11-18; Assimilation Tracks 19-22

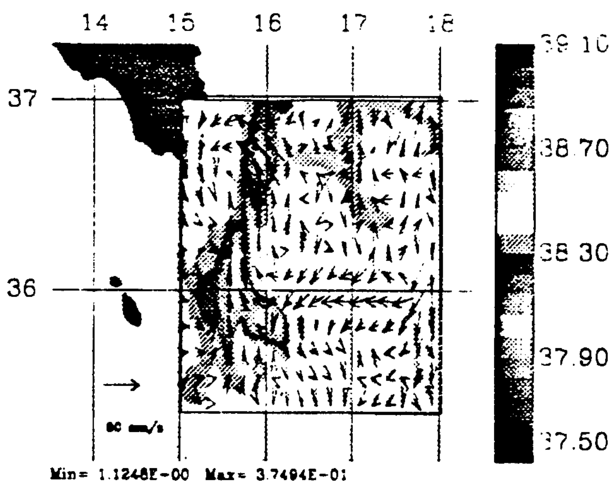
2.50 Day Forecast - 19 Nov 1994



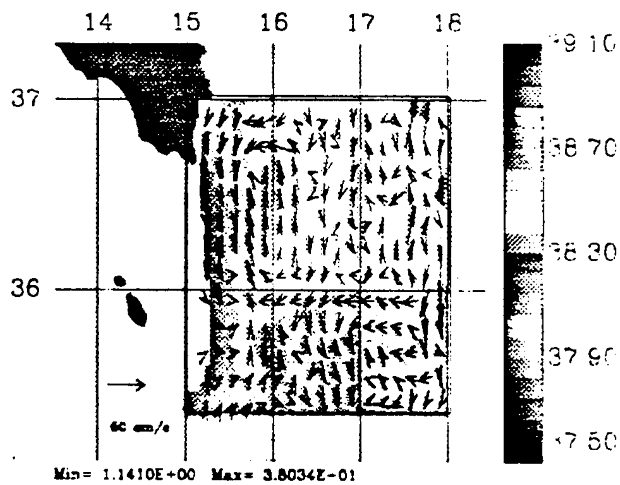
Salinity (PSS) at 15 m



Salinity (PSS) at 75 m



Salinity (PSS) at 125 m



Salinity (PSS) at 225 m

- Phenomenology:

  Atlantic Ionian Stream, Jets, Filaments, Eddies

  Deep Levantine Intermediate Water Flow

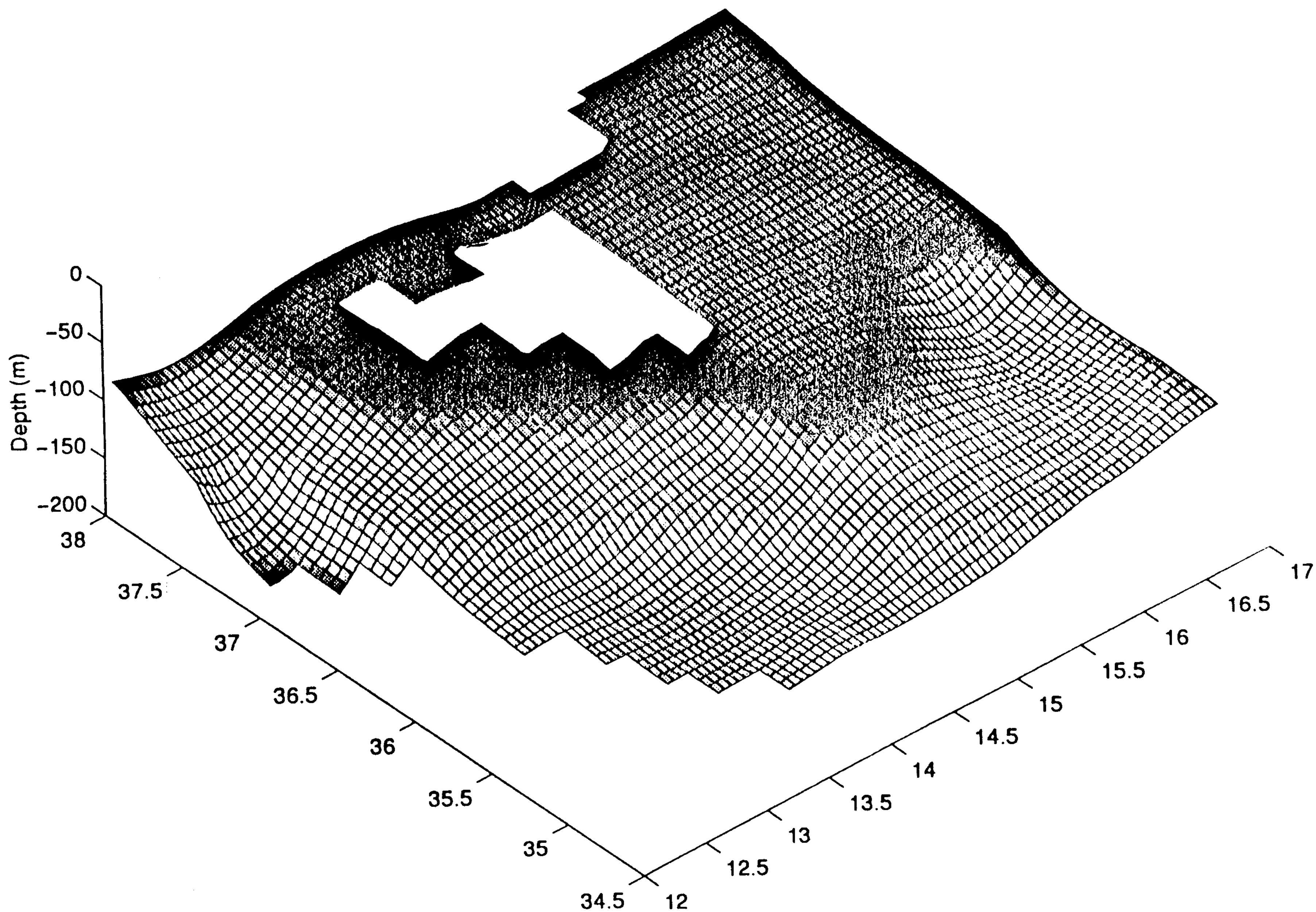
  Wind-driven Coastal Sicilian Current and Upwelling

  Atmospheric Forcings – Winds, Heat Flux, Buoyancy

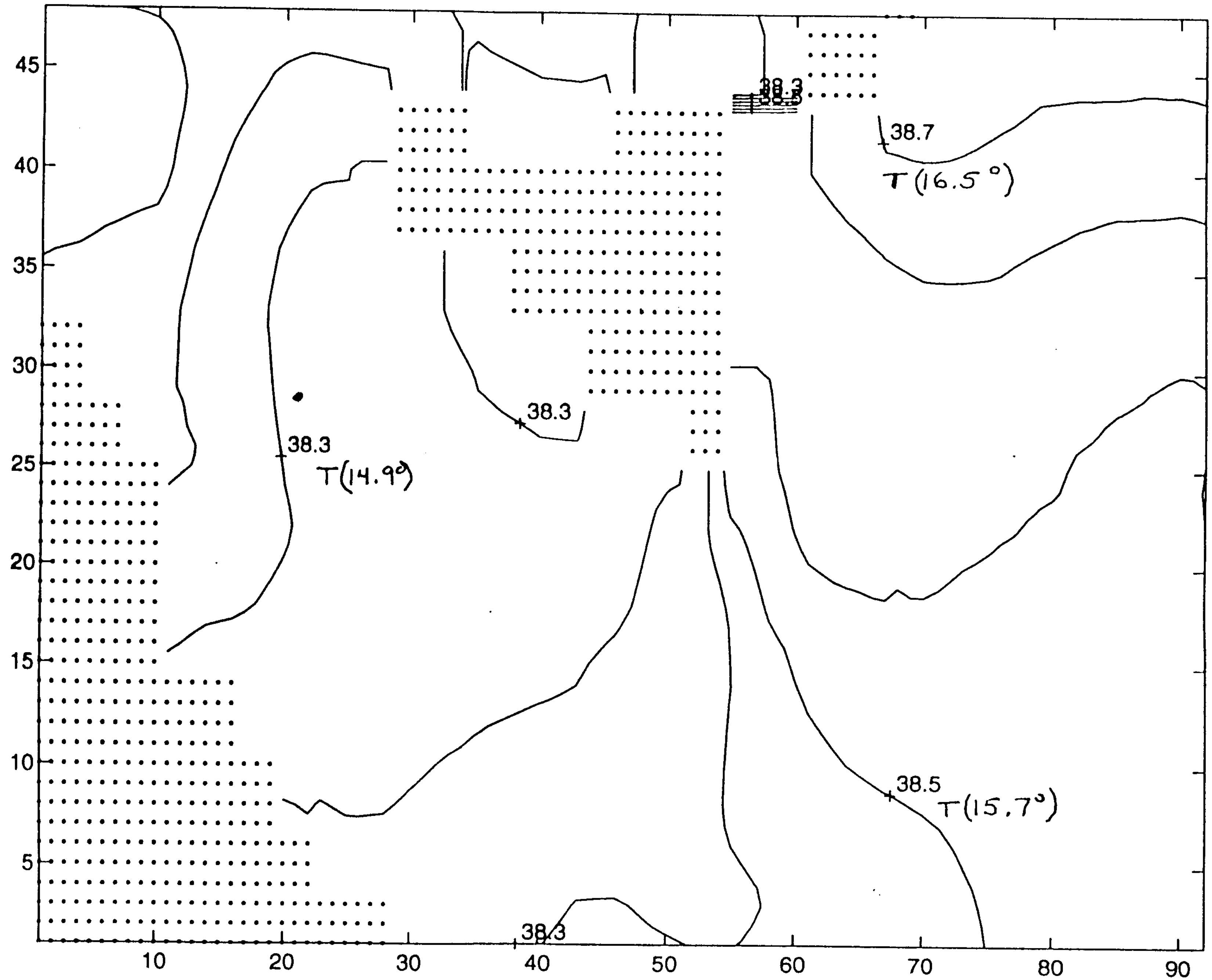
  Mixing of multiple water masses

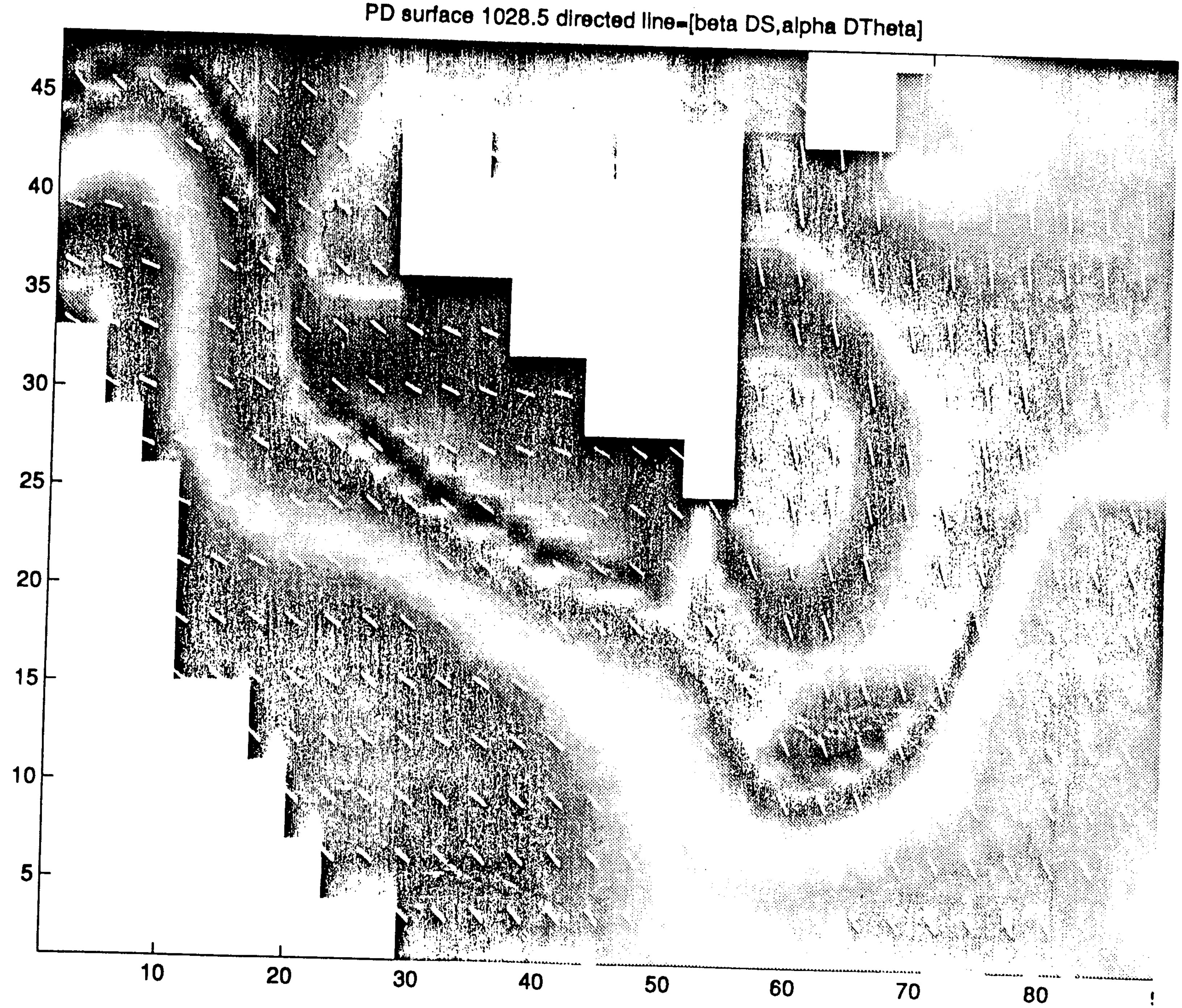
  Surface Flux Transformations

Pot. Density [PD] [1028.5] surface



Salinity at PD = 1028.5




PD surface 1028.5 directed line=[beta DS,alpha DTheta]
45
40
35
30
25
20
15
10
5
10
20
30
40
50
60
70
80

Future Plans

- Tri-modal Real-time Investigation

  Preliminary Expedition [AIS-94]

  Explore and Identify phenomena [Cruise planned in Oct-Nov, 1995].

  Verify and Validate the regional operational model

- Will provide materials and methodology for coastal scene description, consistent with available data, models and historical knowledge of synoptic structures.

MAB: Nested Domains

- Large Domain: 7.5km grid size

  Mesoscale Features over Large-Scale Region [MS-LR]

- Shelf and Slope Domain: 2km grid size

  Sub-mesoscale Features over Mesoscale Region [SMS-MR]

- Shelf Domain: 1/2km grid size

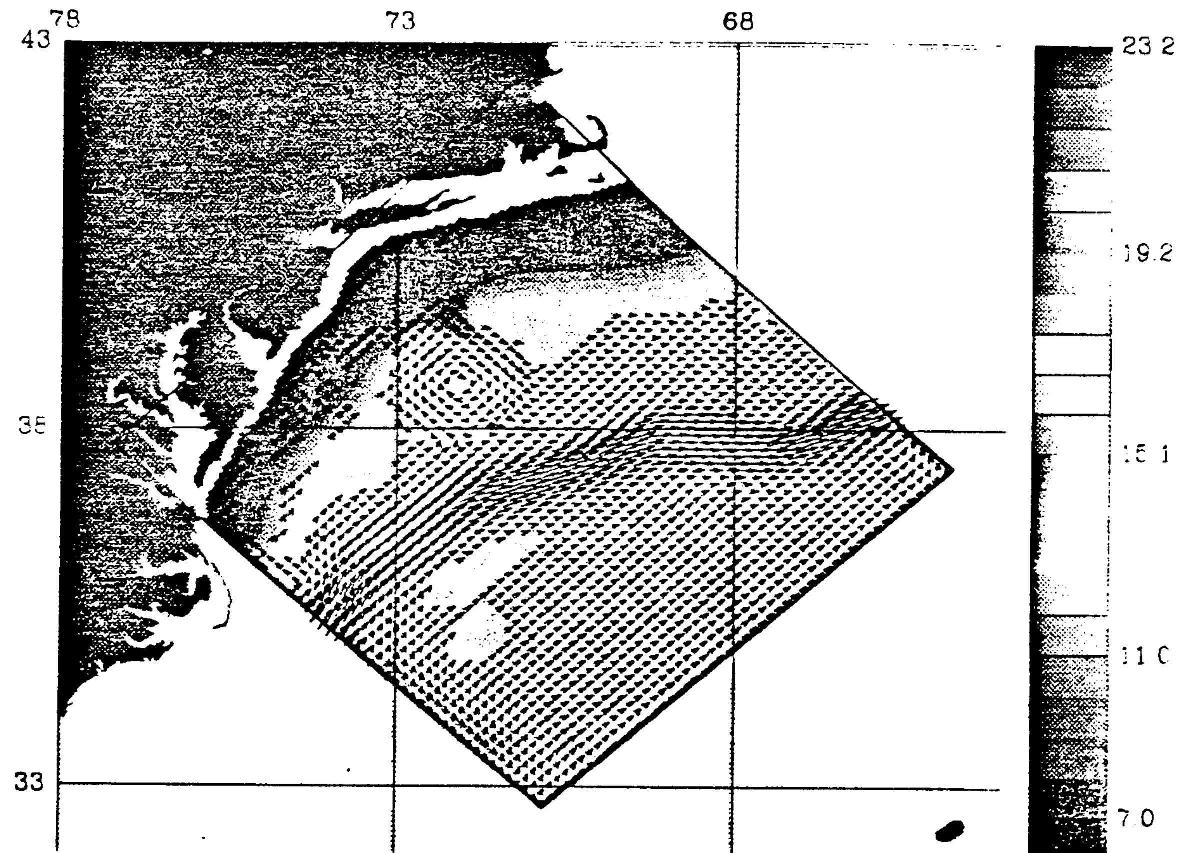
  Support High resolution data over Sub-Mesoscale Region [HR-SMR]

Harvard Primitive Equation Model

Feature Model Initialization + Surface Forcing

Gulf Stream, Ring and Shelfbreak Front

5.00 Day Forecast : 11 May 1987



Temperature (deg C) at 1 m

US National Marine Fisheries Service
MARMAP Data

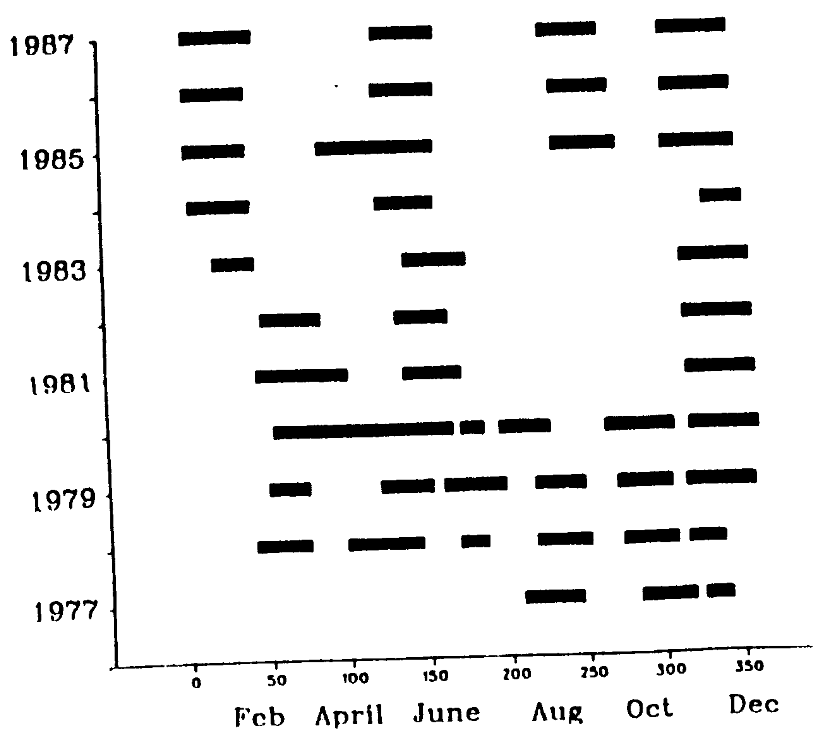
6970 Profiles Collected on 51 Mid-Atlantic Bight Surveys

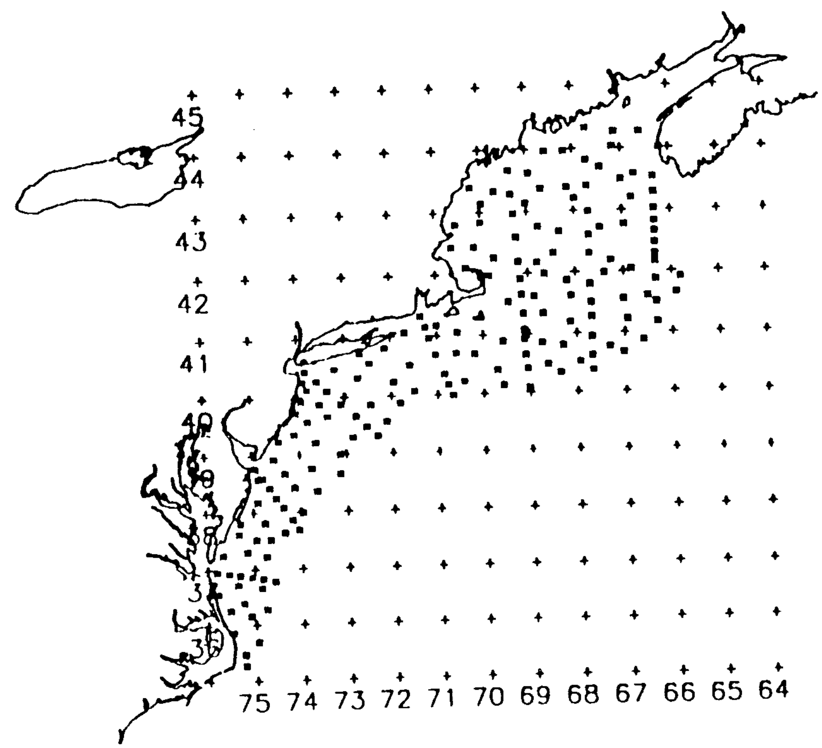
25 Surveys are Hydrographic (P,T,S) Only

26 Surveys include Chlorophyl, Nitrate, Phosphate and Silicate

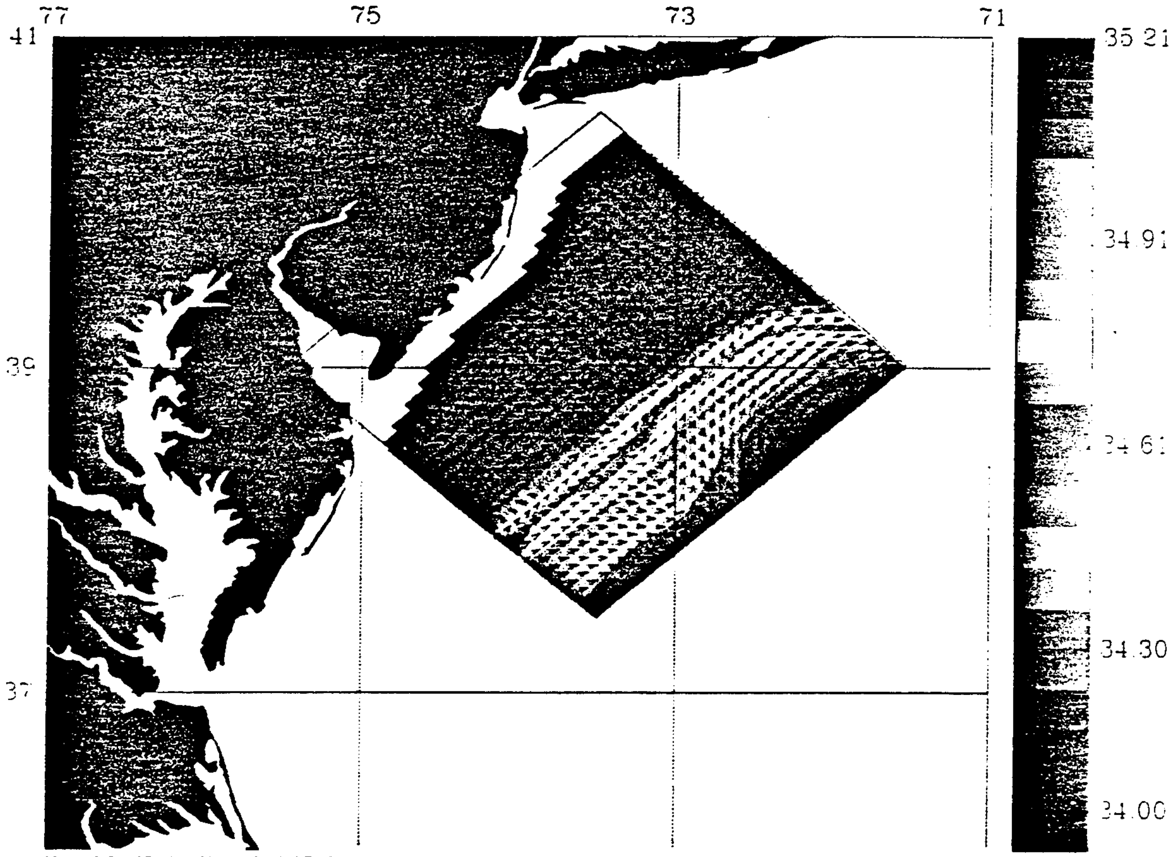
Many Surveys also include Zooplankton

Temporal and Spatial Coverage





New Jersey Coast to Slope
Nowcast : 6 May 1987



Min= 8.5940E-01 Max= 2.8647E-01

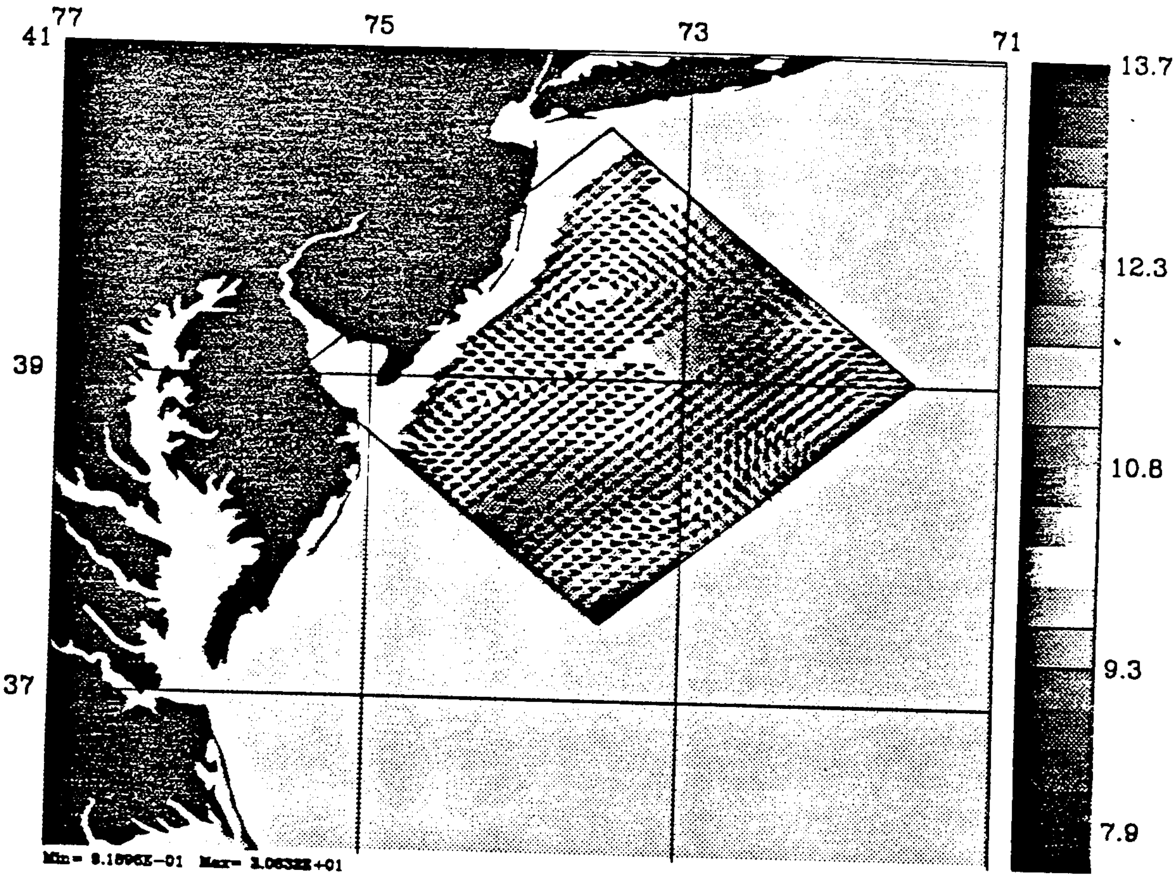
Salinity (PSS) at 1 m

Coastal Scene Description

Nesting Initialization + Data Assimilation

New Jersey Coast to Slope

6 May 1987



Temperature (deg C) at 1 m

- One way nesting: large domain provides initial and boundary conditions to smaller domain(s).

- Two way nesting: large domain provides boundary conditions, smaller domain(s) updates through averaging forcings in the large domain.

- Applications of nesting in CSD:

  1way: Pass remote information to small domains. e.g. Coastal Trapped Waves.

  2way: Provide a consistent propagation of information across domains at reasonable computational cost.

MAB Data Sets

available at

Institute of Marine & Coastal Sciences,
Rutgers University

Scott Glenn
Laurel Henderson
Mike Crowley

Coastal Scene Description

Data Analysis, Feature Model and Data Fusion

Mid Atlantic Bight

South Atlantic Bight

Objective

Analysis and fusion of oceanographic data and models for 3-D coastal scene description in the Middle and South Atlantic Bights.

Approach

*Collect relevant oceanographic and meteorological data.

*Acquire or construct accurate coastline/bathymetry database.

*Compile datasets in a Geographic Information System (GIS).

*Summarize events and trends of interest to CSD participants.

*Distribute required datasets to other CSD participants.

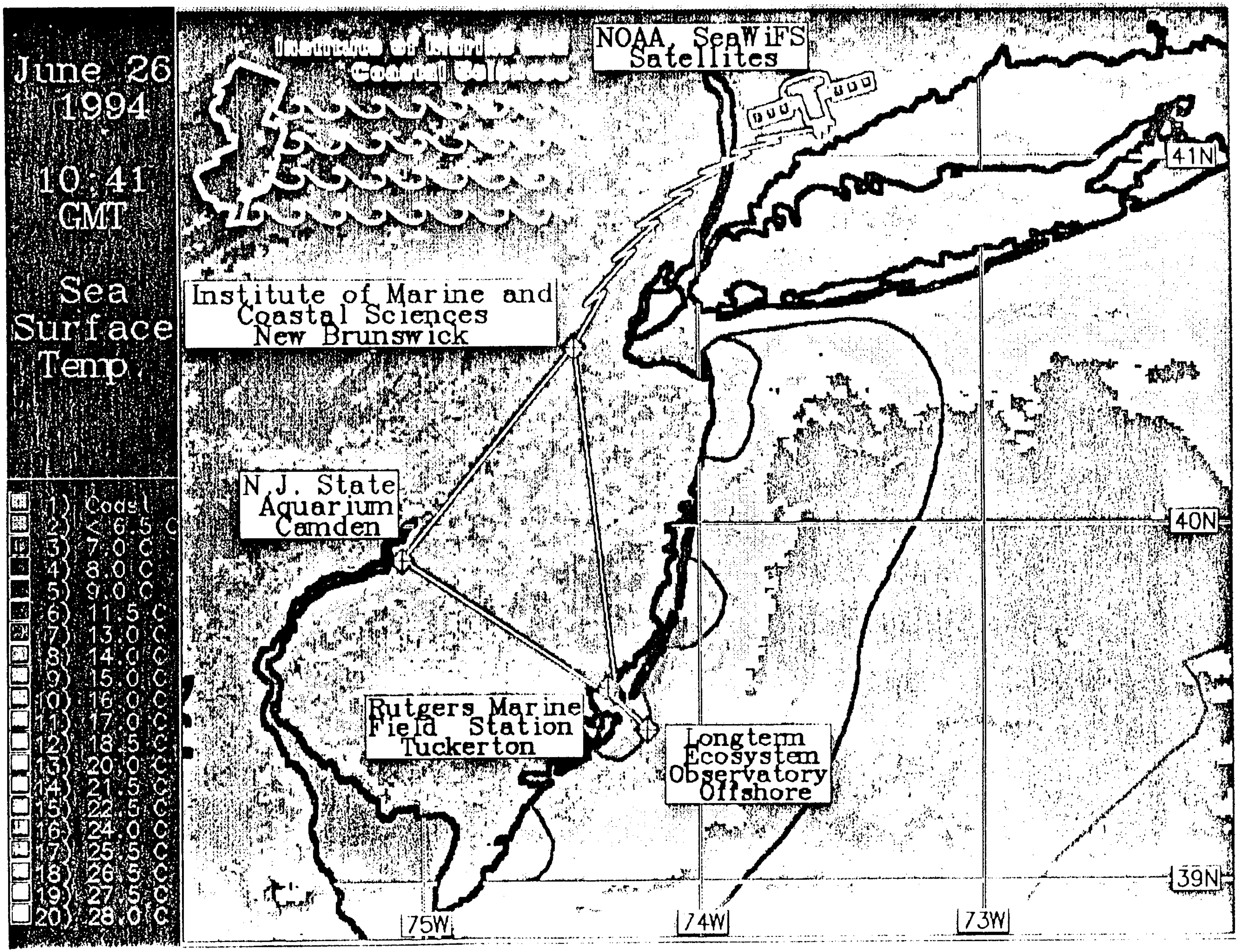
Deliverables

*MAB and SAB oceanographic/meteorological datasets.

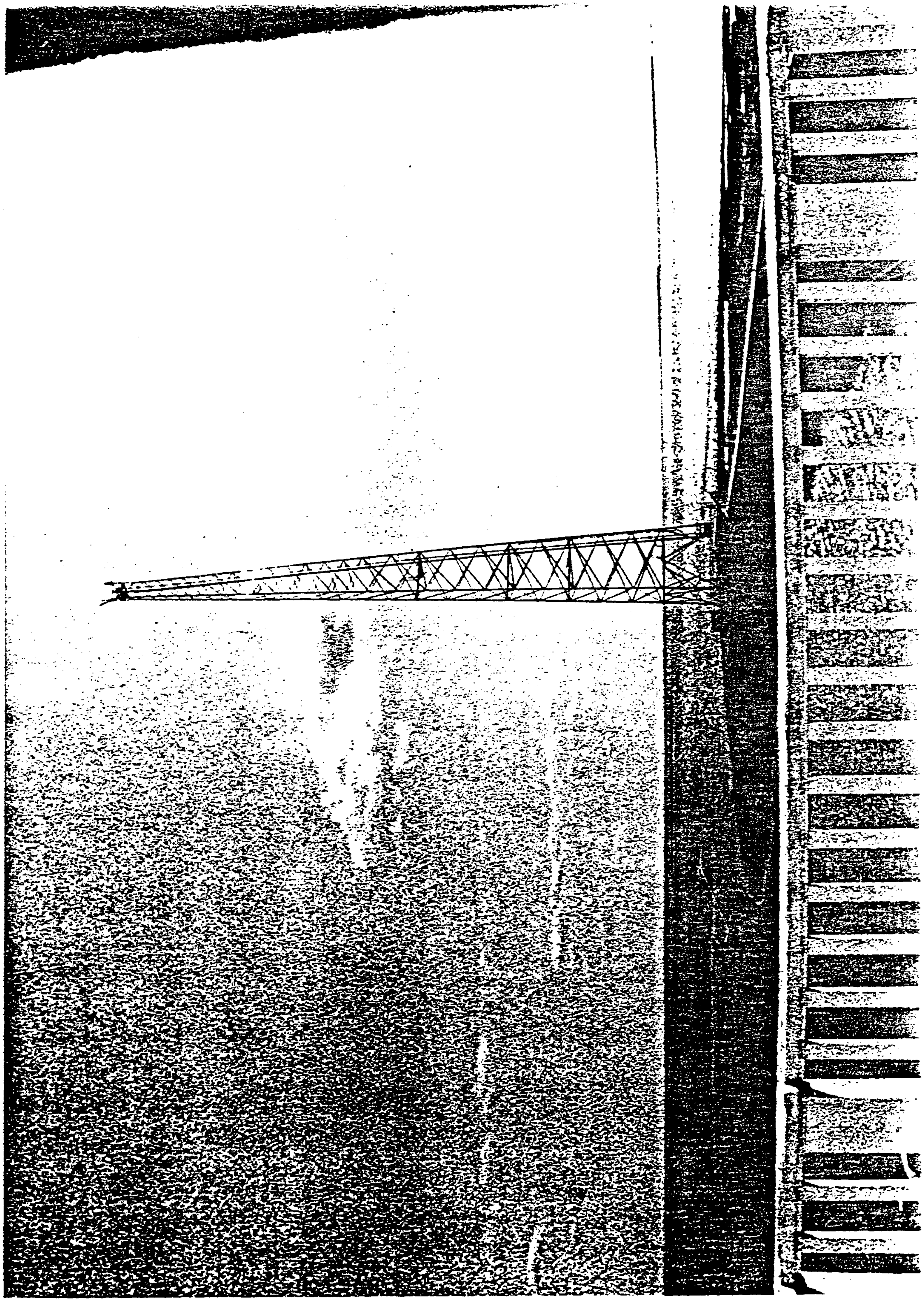
*Accurate coastlines and bathymetry.

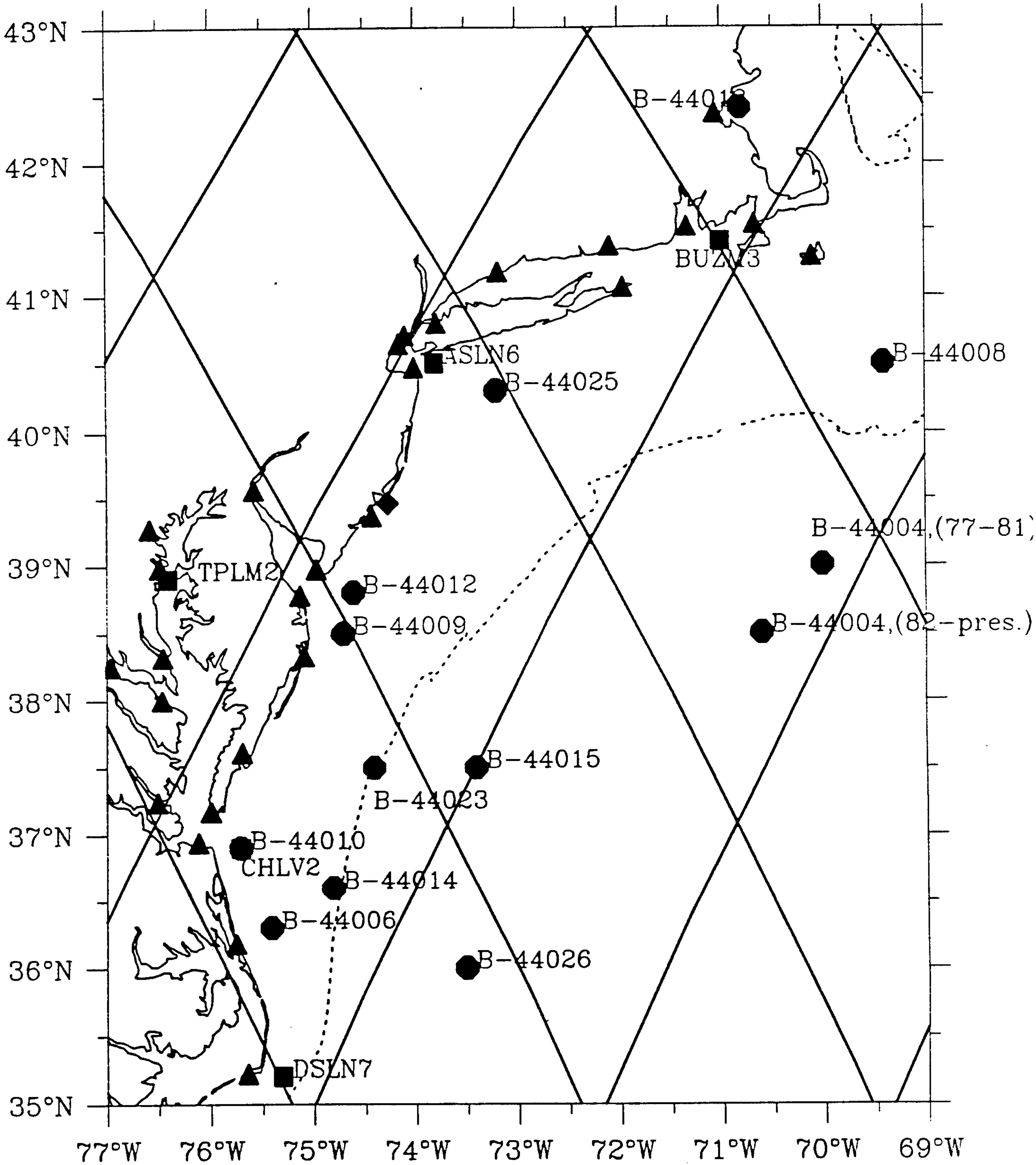
*Geographic Information System.

*Event summaries.

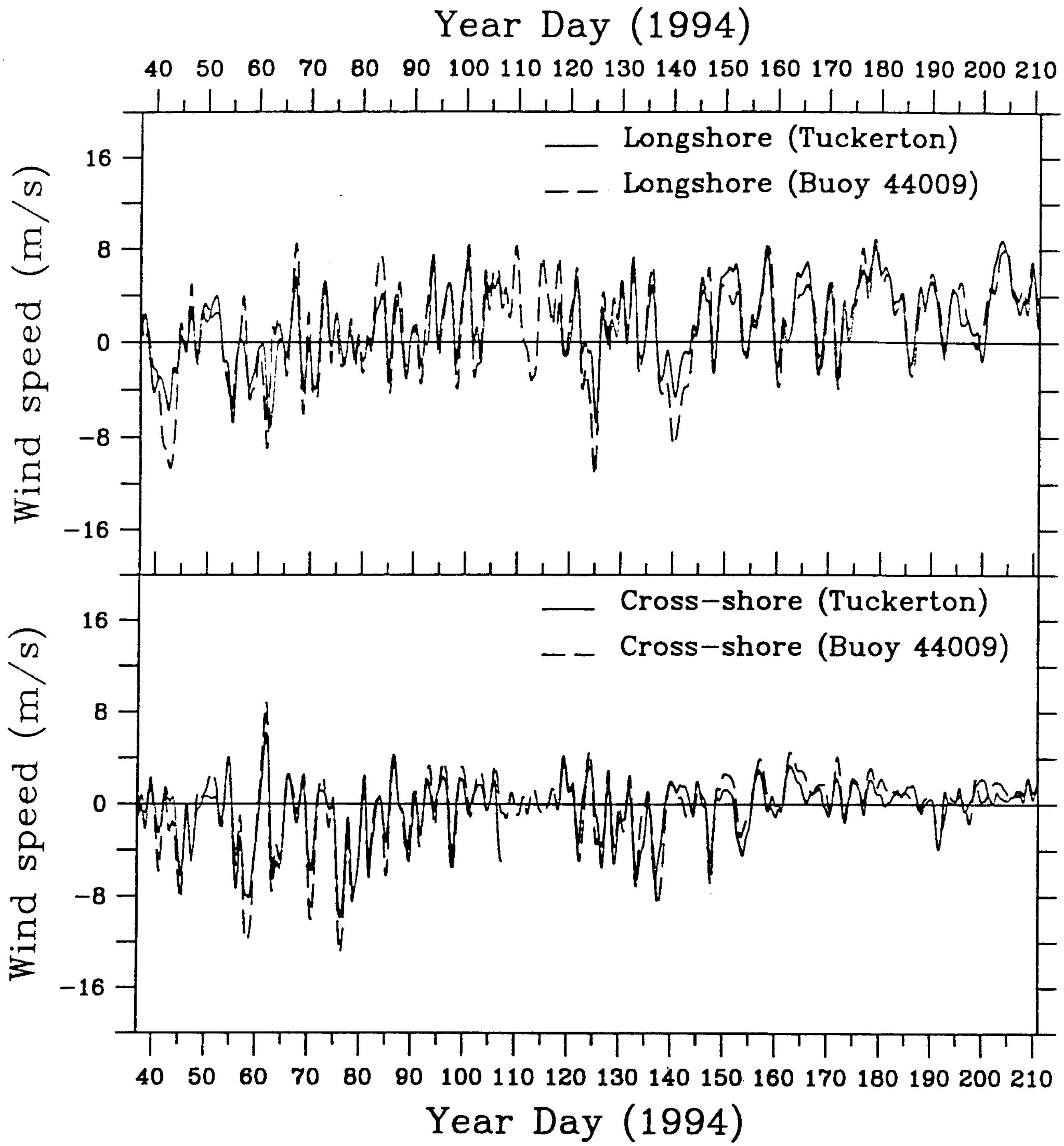


June 26
1994
10:41
GMT
Sea
Surface
Temp.
1) Coast
2) < 6.5 C
3) 7.0 C
4) 8.0 C
5) 9.0 C
6) 11.5 C
7) 13.0 C
8) 14.0 C
9) 15.0 C
10) 16.0 C
11) 17.0 C
12) 18.5 C
13) 20.0 C
14) 21.5 C
15) 22.5 C
16) 24.0 C
17) 25.5 C
18) 26.5 C
19) 27.5 C
20) 28.0 C
NOAA, SeaWiFS
Satellites
Institute of Marine and
Coastal Sciences
New Brunswick
N.J. State
Aquarium
Camden
Rutgers Marine
Field Station
Tuckerton
Longterm
Ecosystem
Observatory
Offshore
41N
40N
39N
75W
74W
73W

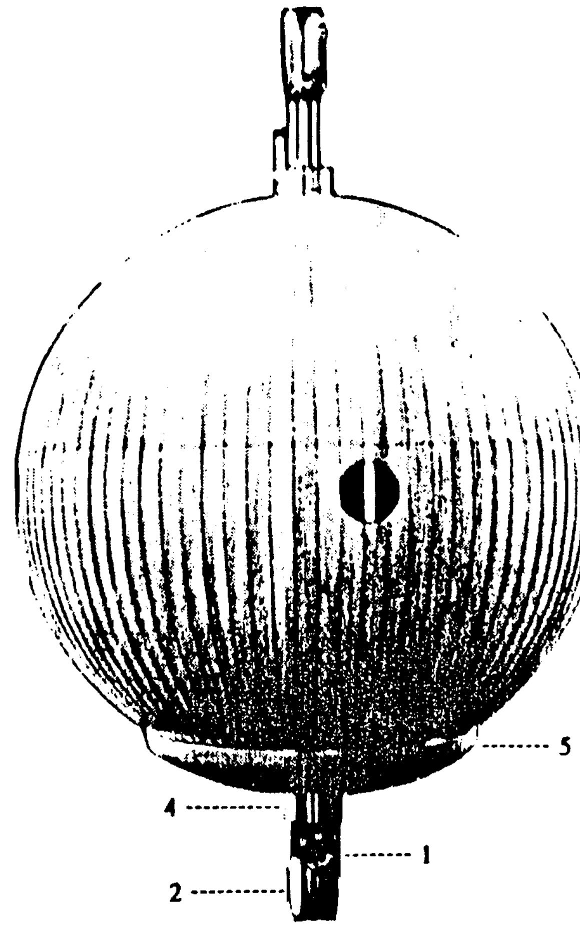




NOAA Buoys, C-MAN & Tide Stations. TOPEX Ground Tracks.



Buoy 44009 vs Tuckerton Wind Sensor



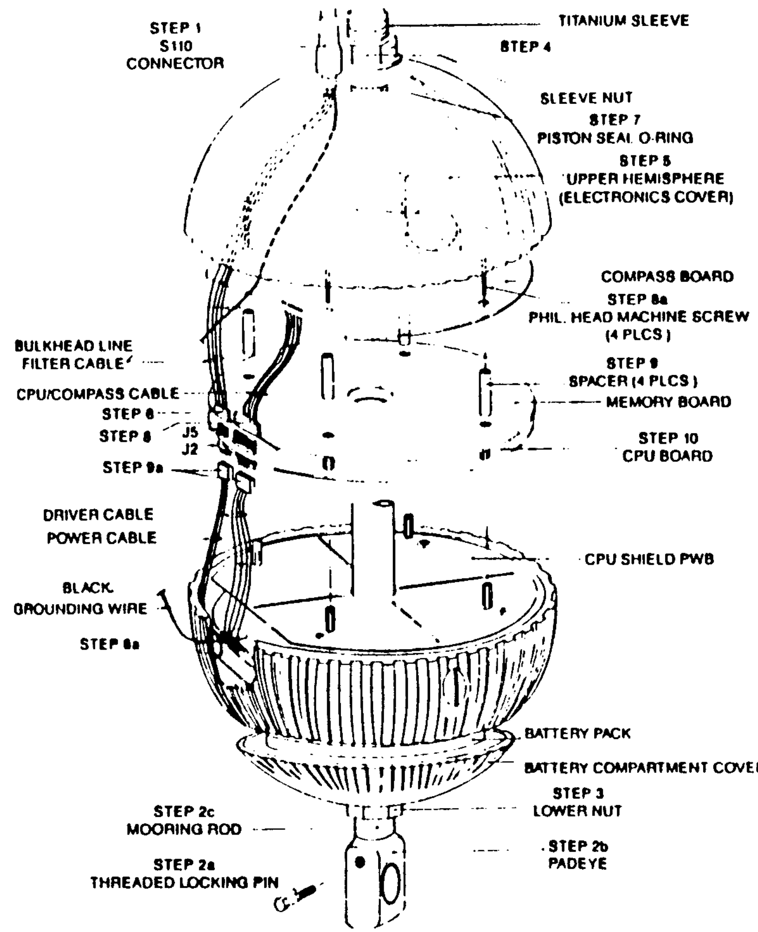
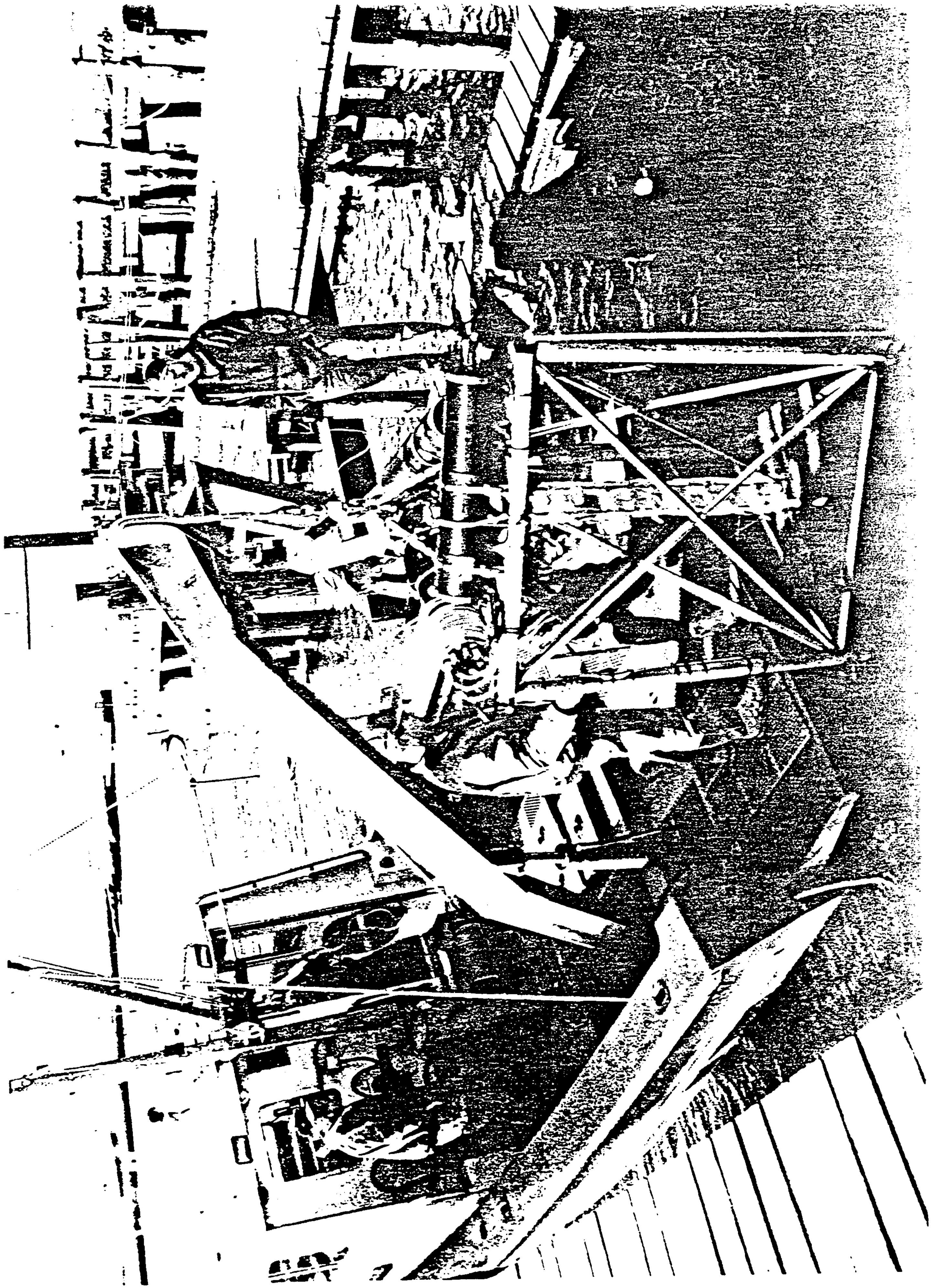
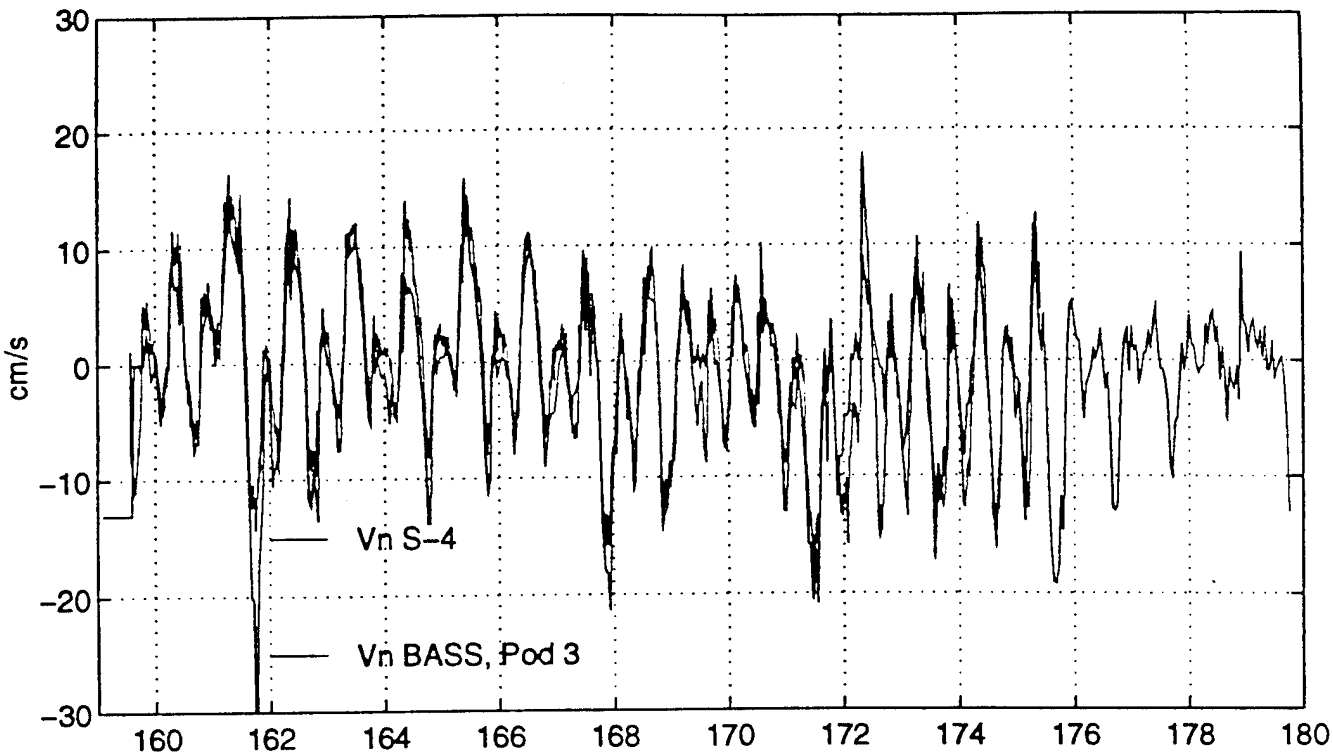


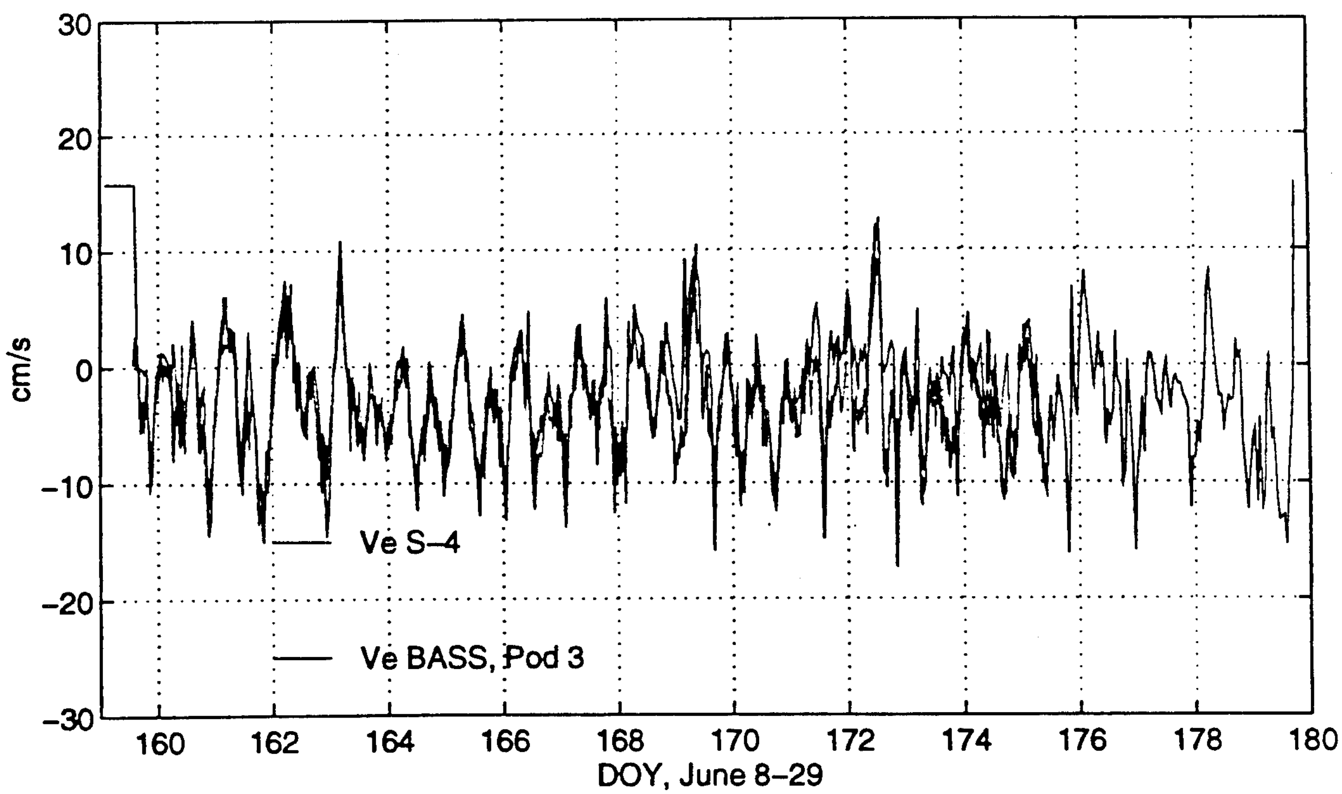
Figure 20: Photo and schematic of InterOcean Systems, Inc. S4 Current Meter.



940608 average Vn and Ve from S-4 .ncp file and from BASS



POD 3



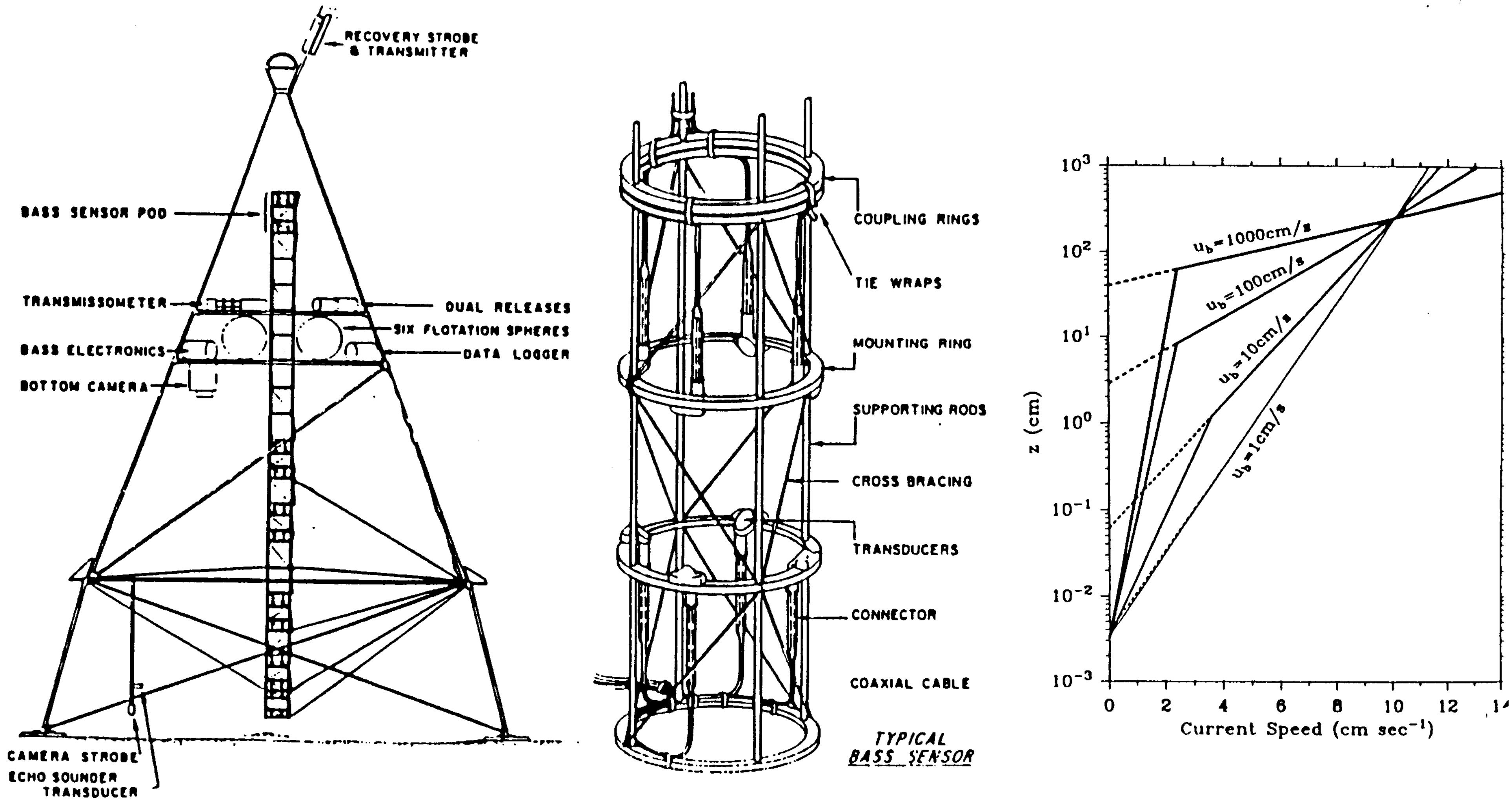
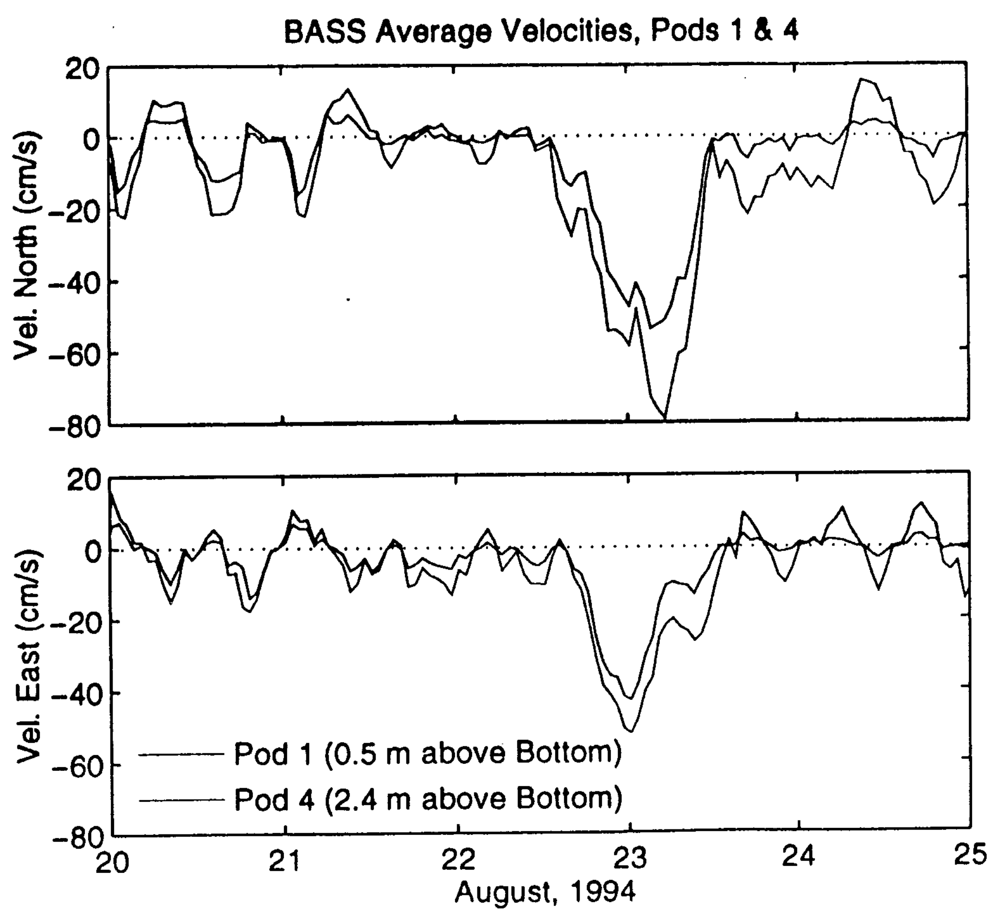
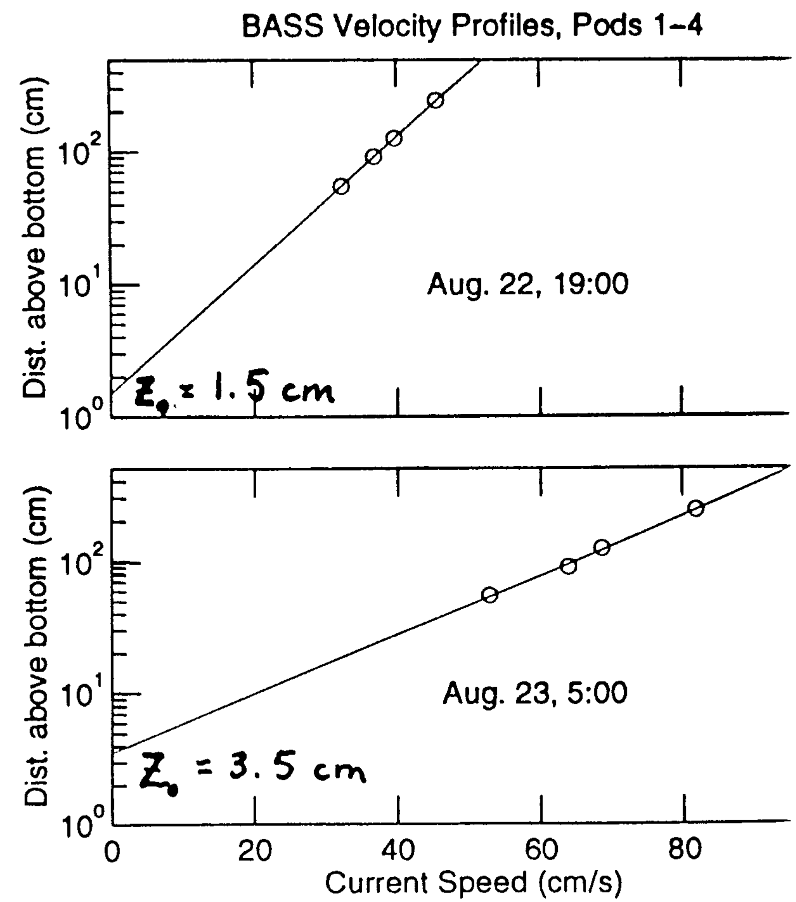


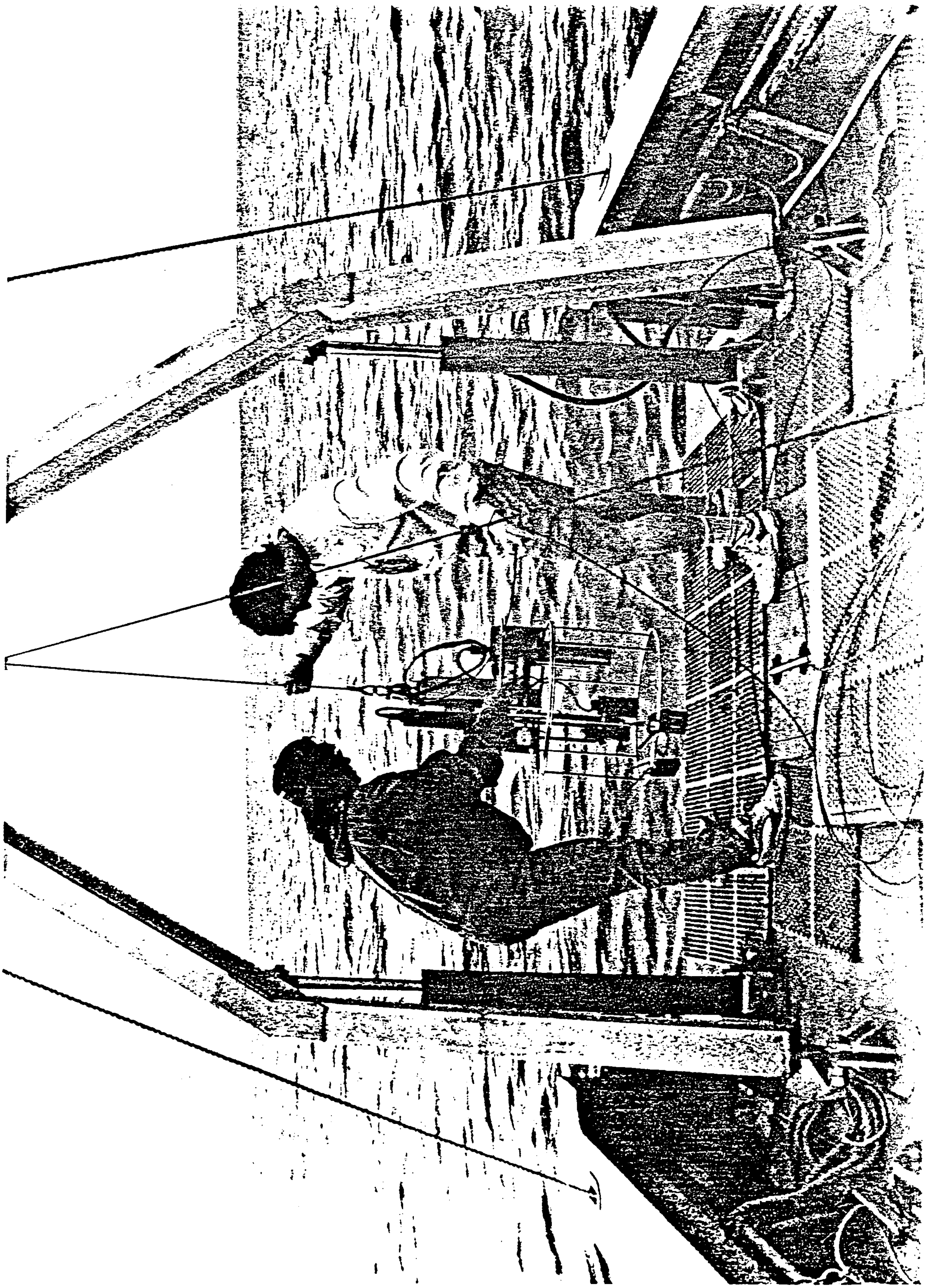
Figure 21: Typical BASS Sensor and BASS Sensor Array

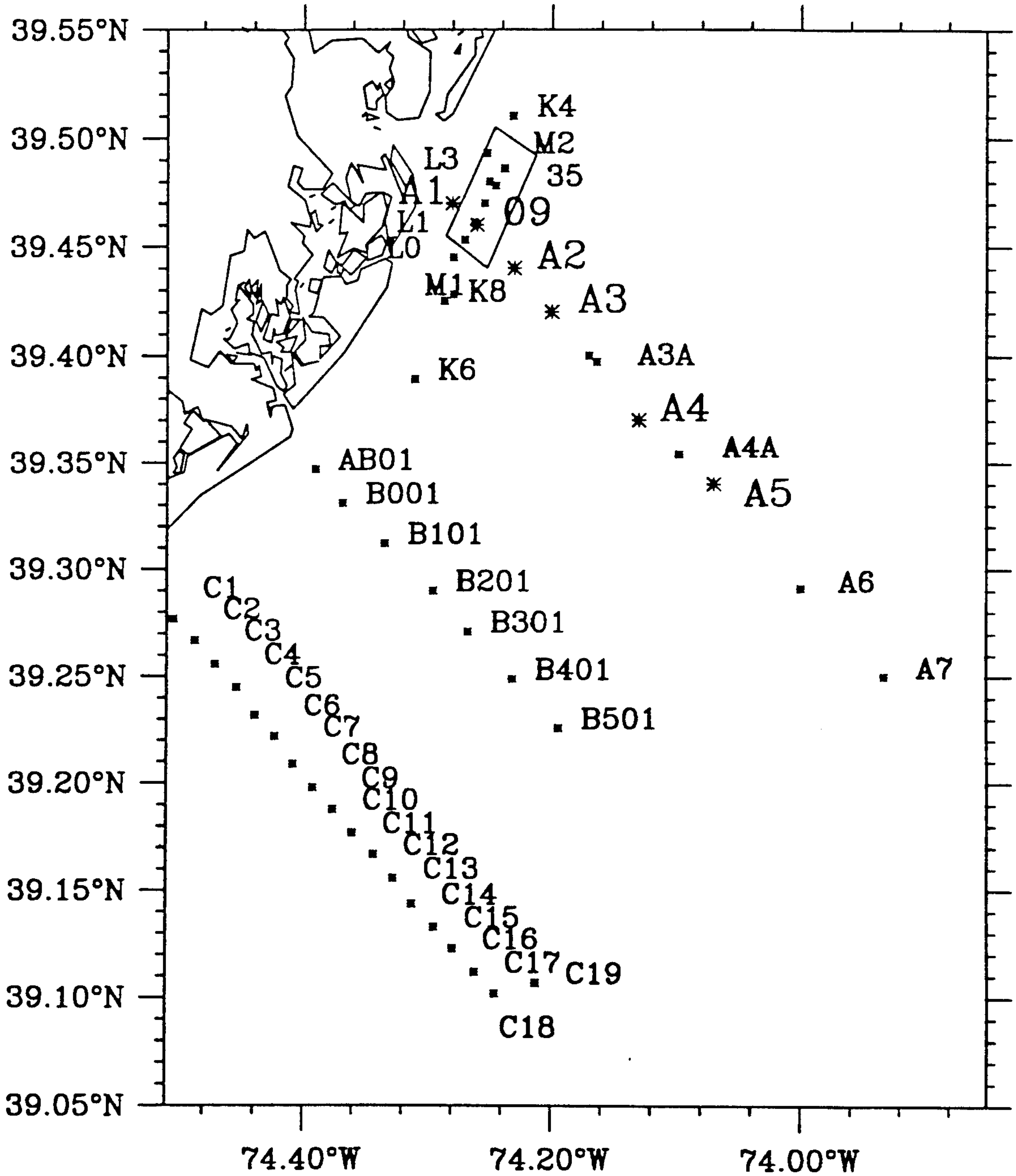


BASS Average Velocities, Pods 1 & 4
Vel. North (cm/s)
Vel. East (cm/s)
Pod 1 (0.5 m above Bottom)
Pod 4 (2.4 m above Bottom)
August, 1994



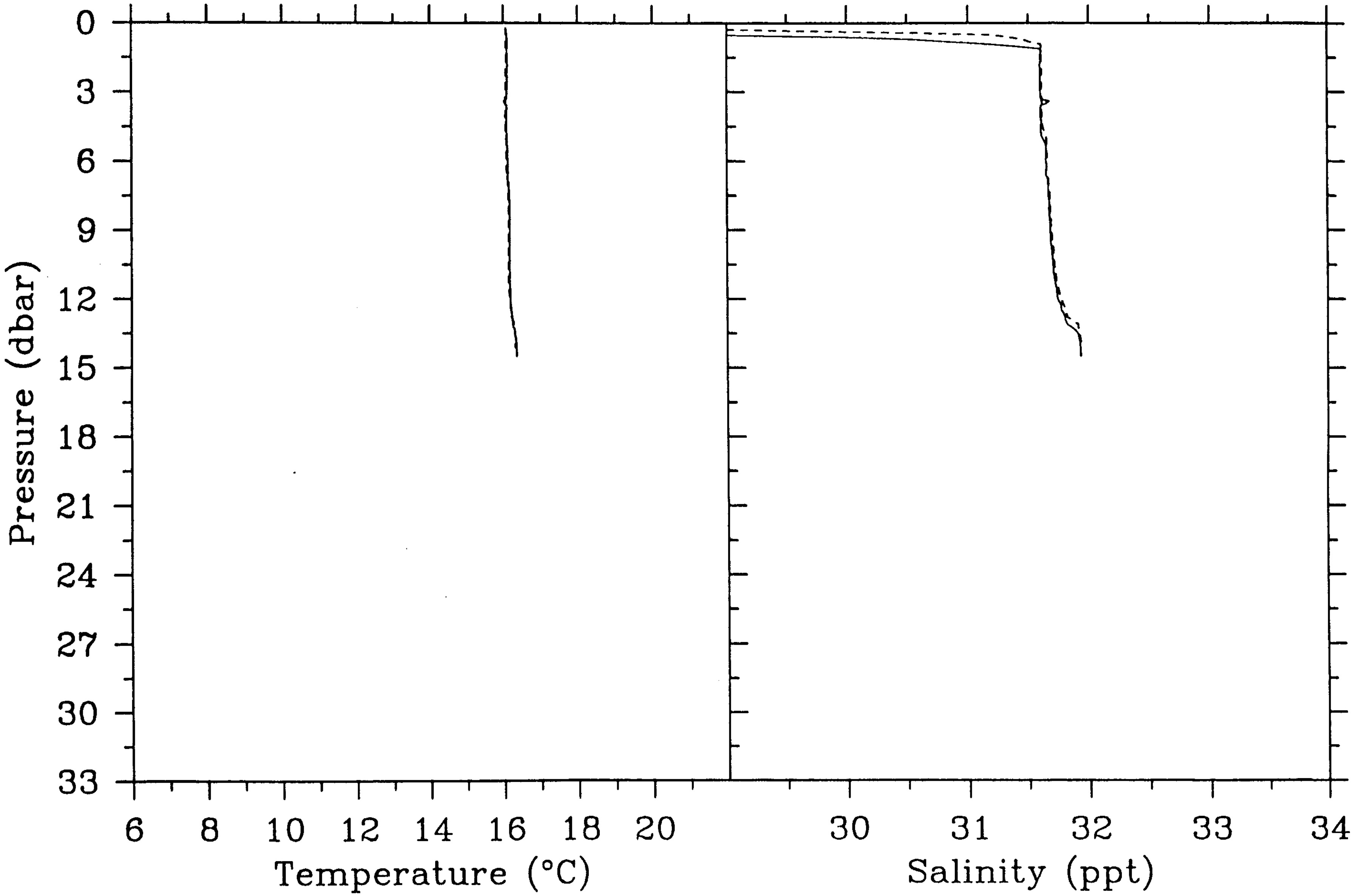
BASS Velocity Profiles, Pods 1–4
Dist. above bottom (cm)
Aug. 22, 19:00
Z_0 = 1.5 cm
Aug. 23, 5:00
Z_0 = 3.5 cm
Current Speed (cm/s)



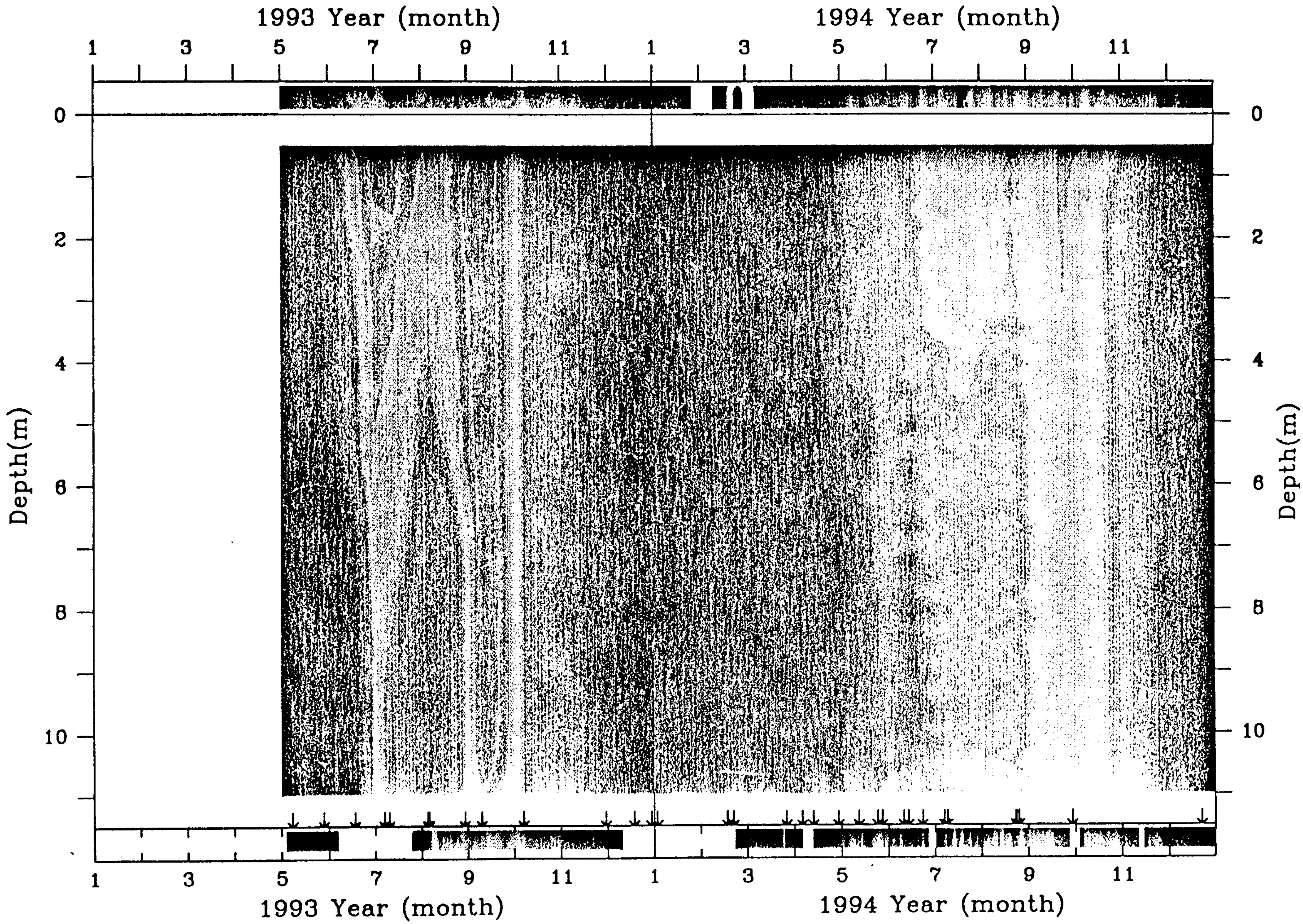


Locations of LEO−15 CTD Surveys: 1994

LEO-15 CTD Surveys: October 25, 1994

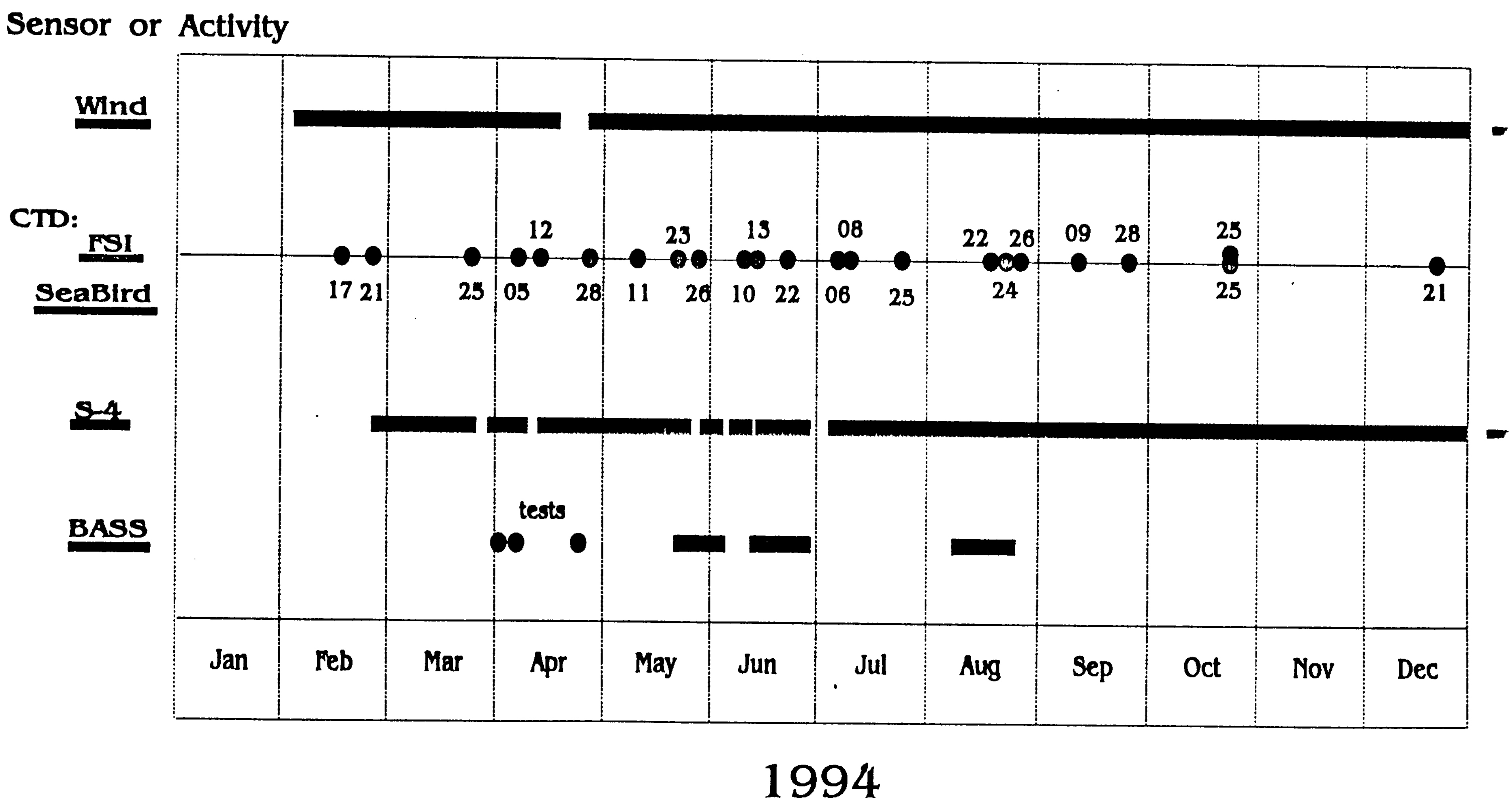


Downcasts: FSI (solid) & SeaBird (dash): a201

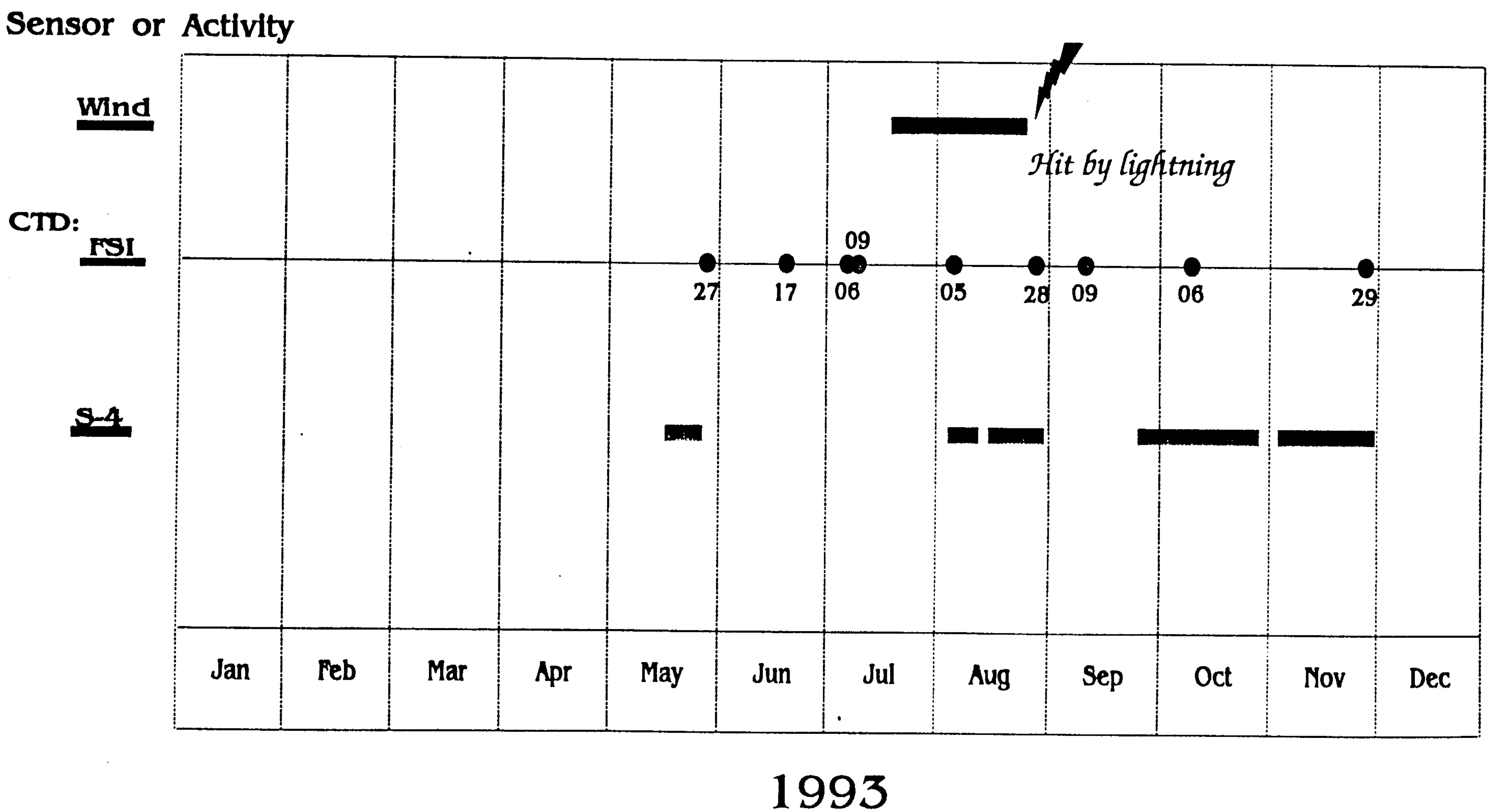


1993 Year (month)
1994 Year (month)
1
3
5
7
9
11
1
3
5
7
9
11
Depth(m)
0
2
4
6
8
10
Depth(m)
0
2
4
6
8
10
1
3
5
7
9
11
1
3
5
7
9
11
1993 Year (month)
1994 Year (month)

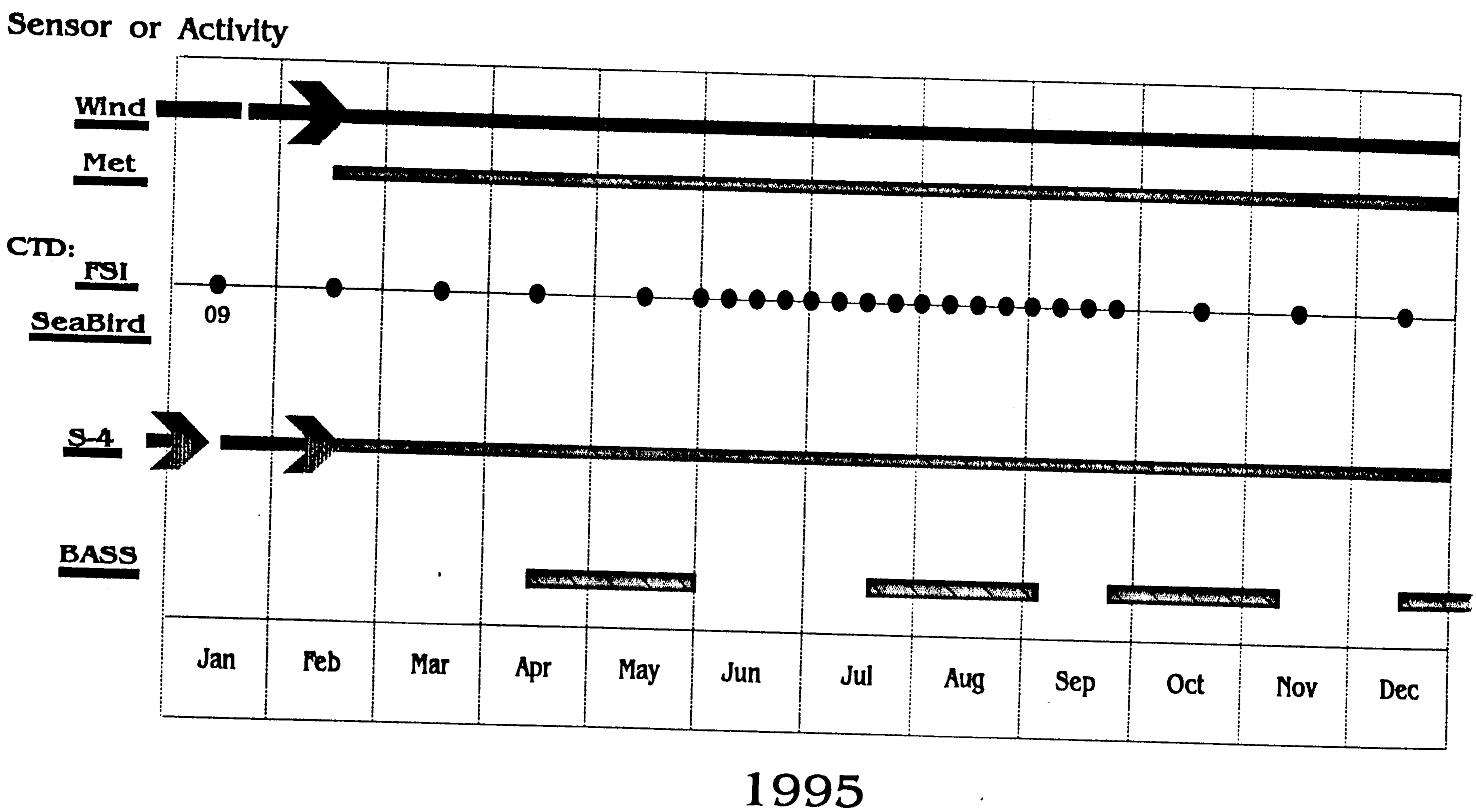
Operational Periods for Sensors and Measurements at the LEO-15 Site

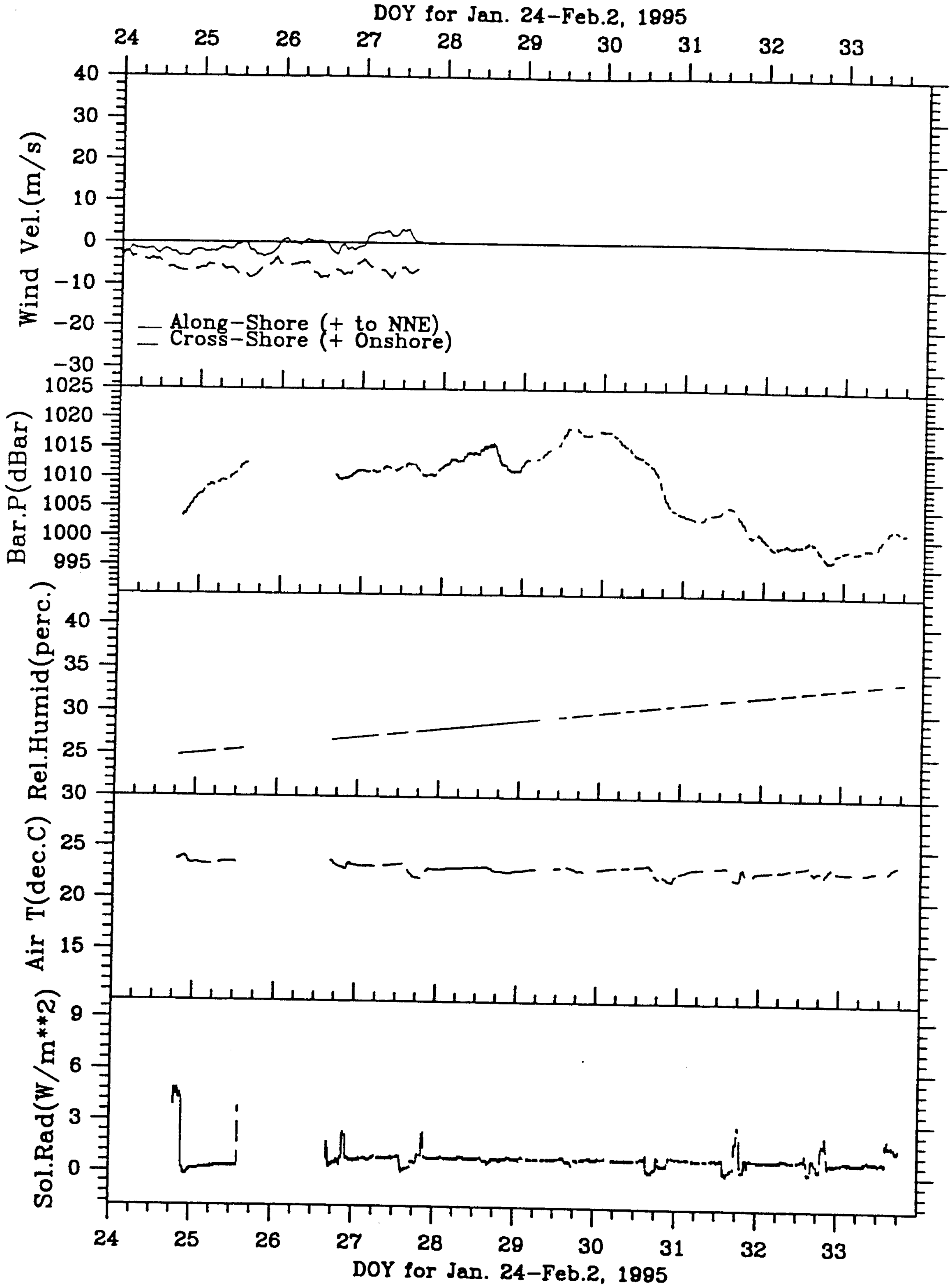


Operational Periods for Sensors and Measurements at the LEO-15 Site



Operational Periods for Sensors and Measurements at the LEO-15 Site

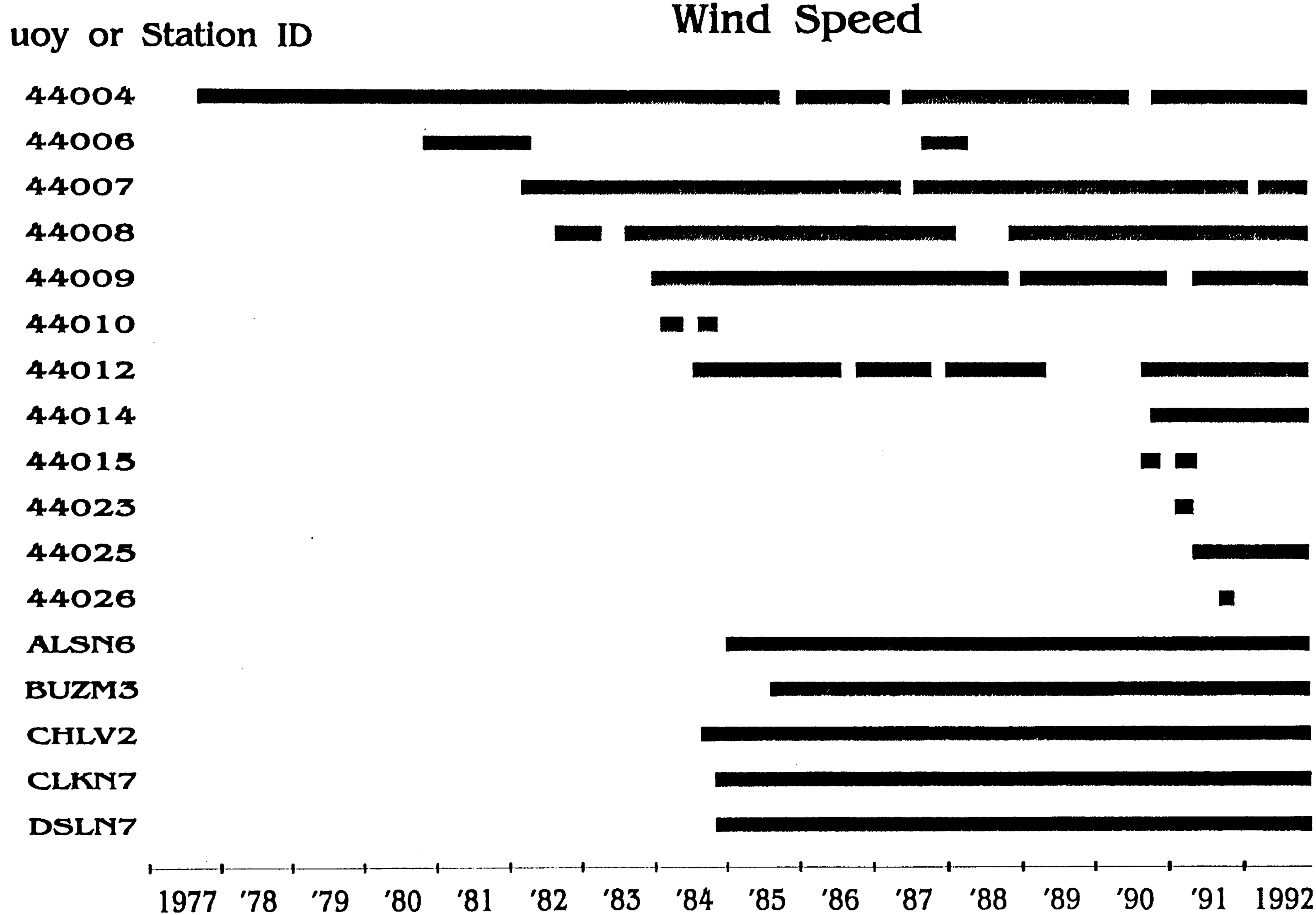




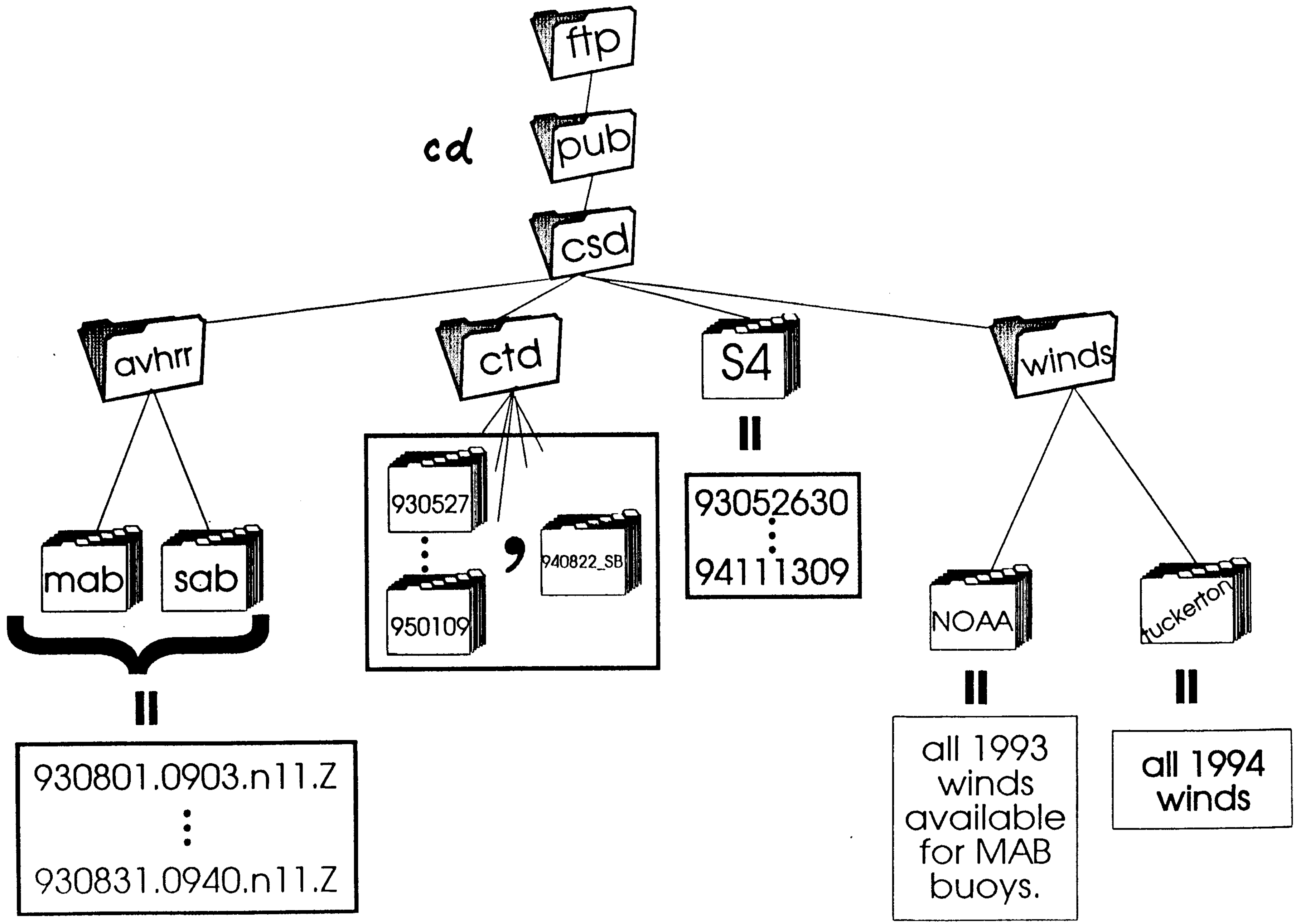
Met Data: Jan.–Feb. lab tests, 1995

Operational Periods for Buoys and C-MAN Stations

Wind Speed



anonymous ftp to arctic.rutgers.edu



README

This directory contains data from the S-4 Current Meter.

Each file contains 9 columns of data:

Dec.DOY	Decimal Day-of-Year (what some people call Julian Day)
U(cm/s)	Hourly averaged velocity parallel* to the NJ coast (+ NNW)
V(cm/s)	" " " perpendicular* to the NJ coast (+ onshore)
Depth(m)	Water depth (meters).
Temp(deg)	Temperature (degrees Celsius).
Sal(psu)	Salinity (psu).
Hs(m)	Significant wave height.
Tp(s)	Peak period of the waves.
OBS(FTU)	Optical back-scatter.

* The coastline of New Jersey near LEO-15 is oriented 20 deg. E. of true North.

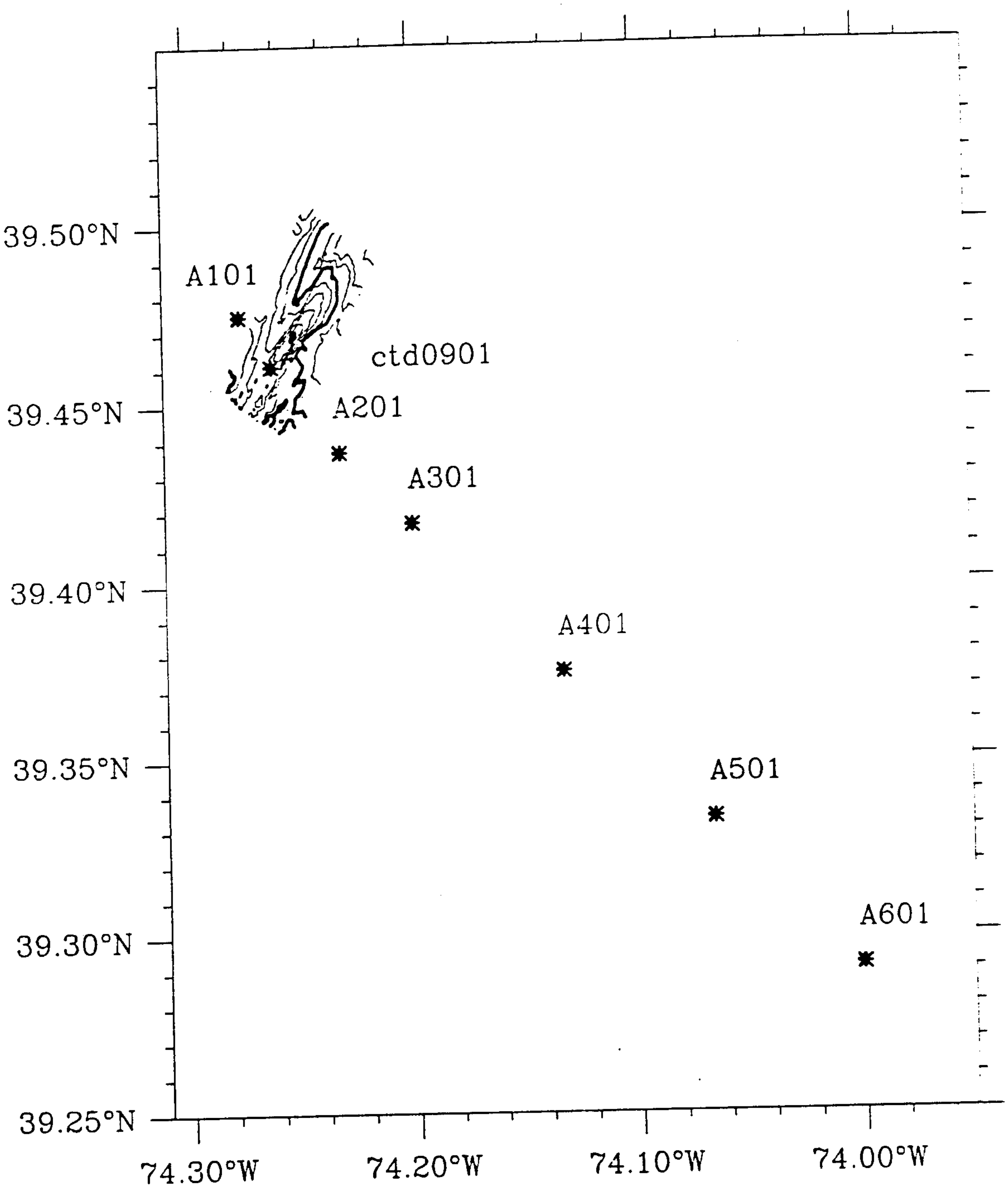
Inside every file, time is given as day-of-year (1 to 365), but the names of the files follow the convention YYMMDDst.dat. For example, file pub/csd/leo15/93080409.dat starts on August 4, 1993, and was at Station 09.
The first line of data is 216.7500, showing that data collection began on DOY 216 (August 4) at .75 hours = 18:00Z.

Station	Latitude(N)		Longitude(W)	
	Deg.	Min.	Deg.	Min.
09	39	27.70	74	15.73
30	39	28.81	74	13.22
20	39	26.36	74	14.54

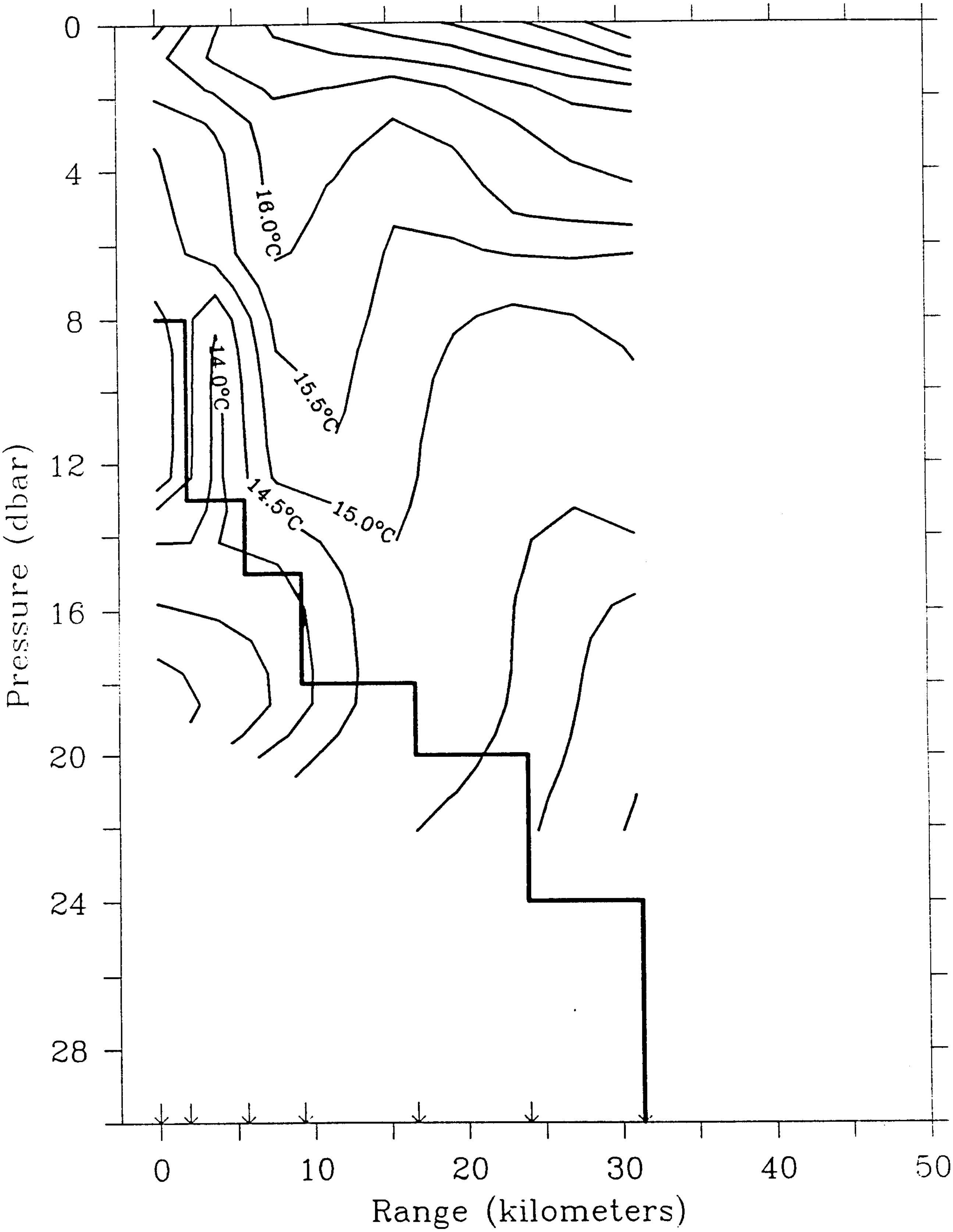
README

Contents of directory ftp/pub/csd/ctd/940824:

```
README              this file.
position.dat        list of CTD locations for this survey.
pd0901.avg Down-cast data for each CTD.  Data has had pitching motion
pda101.avg   of ship filtered out.
pda201.avg
pda301.avg
pda401.avg
pda501.avg
pda601.avg
Tsection.ps         postscript file of contoured temperature data.
map.ps              postscript file of location map.
```



LEO−15 CTD Survey: August 24, 1994



August 24, 1994: Temperature

position.dat

CTD	N.LAT (DEG	MIN)	W.LON (DEG	MIN)	DEPTH (Meters)	DATE
A101	39	28.51	74	16.56	8.0	24-AUG-1994
0901	39	27.68	74	15.75	13.0	24-AUG-1994
A201	39	26.23	74	13.95	15.0	24-AUG-1994
A301	39	24.99	74	11.97	18.0	24-AUG-1994
A401	39	22.47	74	7.99	20.0	24-AUG-1994
A501	39	20.01	74	3.99	24.0	24-AUG-1994
A601	39	17.46	74	0.00	31.0	24-AUG-1994

pd0901.avg

icount	pressure	temp	conductiv.	salin.	O2_c	O2_t	transmis.	fluorom.
1	0.4000	16.0249	38.9126	31.3334	2.0546	19.4631	1.1554	1.6921
2	0.5000	15.9540	38.9126	31.3916	2.0546	19.4631	1.2401	1.7058
3	0.6000	15.8335	38.9126	31.4831	2.0546	19.4631	1.3670	1.7263
4	0.7000	15.8067	38.9126	31.4904	2.0546	19.4631	6.7647	1.7065
5	0.8000	15.7741	38.9126	31.5041	2.0546	19.4631	31.5939	1.6153
6	0.9000	15.7459	38.9126	31.5220	2.0546	19.4631	44.7588	1.4710
7	1.0000	15.7393	38.9126	31.4983	2.0546	19.4631	45.0660	1.3701
8	1.1000	15.7401	38.9126	31.4786	2.0546	19.4631	45.2260	1.3434
9	1.2000	15.7318	38.9126	31.5087	2.0546	19.4631	45.3021	1.3823
10	1.3000	15.7227	38.9126	31.5274	2.0546	19.4631	45.4861	1.4006
11	1.4000	15.7191	38.9126	31.5328	2.0546	19.4631	45.6095	1.4035
12	1.5000	15.7226	38.9126	31.5468	2.0546	19.4631	45.7964	1.4075

•

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To access data sets online at the Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey:

```
ftp arctic.rutgers.edu          (or, ftp 128.6.141.21)
login: anonymous
password:  use your e-mail address as the password

cd /pub/csd

cd to your desired directory.
say: bin
     prompt
     mget *
```

If you have any problems, email
laurel@ahab.rutgers.edu
crowley@atlantic.rutgers.edu
styles@arctic.rutgers.edu
or
glenn@caribbean.rutgers.edu

The following is a listing of all of the sub-directories and a representative listing of the files available. File names are often in the format YYMMDDSt, where YY = year, MM = month, DD = day, and St = Station.

```
total 5
-rw-r--r--   193 Feb 13 11:59 README
drwxrwxr-x   512 Jul 20  1994 avhrr
drwxrwxr-x  1024 Feb  2 12:15 ctd
drwxrwxr-x   512 Jan 31 15:40 s4
drwxrwxr-x   512 Feb 10 12:16 winds

avhrr/mab:
total 7196
-rw-rwxr-- 245581 Jul  7  1994 930801.0903.n11.Z
-rw-rwxr-- 193128 Jul  7  1994 930801.2028.n11.Z
-rw-rwxr-- 217525 Jul  7  1994 930802.0851.n11.Z
-rw-rwxr-- 198489 Jul  7  1994 930802.2016.n11.Z
-rw-rwxr-- 217779 Jul  7  1994 930805.2334.n12.Z
-rw-rwxr-- 200489 Jul  7  1994 930809.1228.n12.Z
-rw-rwxr-- 203975 Jul  7  1994 930809.2031.n11.Z
-rw-rwxr-- 235841 Jul  7  1994 930809.2348.n12.Z
-rw-rwxr-- 225759 Jul  7  1994 930810.0854.n11.Z
-rw-rwxr-- 199207 Jul  7  1994 930813.0024.n12.Z
-rw-rwxr-- 219199 Jul  7  1994 930814.0946.n11.Z
-rw-rwxr-- 215153 Jul  7  1994 930815.0934.n11.Z
-rw-rwxr-- 276012 Jul  7  1994 930818.2355.n12.Z
-rw-rwxr-- 231415 Jul  7  1994 930819.0845.n11.Z
-rw-rwxr-- 275382 Jul  7  1994 930819.2333.n12.Z
-rw-rwxr-- 190274 Jul  7  1994 930823.2101.n11.Z
-rw-rwxr-- 252961 Jul  7  1994 930823.2347.n12.Z
-rw-rwxr-- 234035 Jul  7  1994 930824.0925.n11.Z
-rw-rwxr-- 209589 Jul  7  1994 930825.2037.n11.Z
-rw-rwxr-- 194325 Jul  7  1994 930826.0900.n11.Z
-rw-rwxr-- 187283 Jul  7  1994 930826.1303.n12.Z
-rw-rwxr-- 212347 Jul  7  1994 930826.2025.n11.Z
-rw-rwxr-- 164685 Jul  7  1994 930827.0023.n12.Z
-rw-rwxr-- 193721 Jul  7  1994 930827.1241.n12.Z
-rw-rwxr-- 207075 Jul  7  1994 930827.2012.n11.Z
-rw-rwxr-- 189541 Jul  7  1994 930828.0002.n12.Z
-rw-rwxr-- 173239 Jul  7  1994 930828.1016.n11.Z
-rw-rwxr-- 167917 Jul  7  1994 930828.1220.n12.Z
-rw-rwxr-- 152099 Jul  7  1994 930828.2000.n11.Z
```

```
-rw-rwxr-- 182070 Jul  7  1994 930830.0952.n11.Z
-rw-rwxr-- 142523 Jul  7  1994 930830.1317.n12.Z
-rw-rwxr-- 147153 Jul  7  1994 930830.1936.n11.Z
-rw-rwxr-- 167551 Jul  7  1994 930831.0037.n12.Z
-rw-rwxr-- 234767 Jul  7  1994 930831.0940.n11.Z
-rw-rwxr--    762 Jul  7  1994 README
-rw-rwxr--   2111 Jul  7  1994 temps

avhrr/sab:
total 8084
-rw-rwxr-- 196872 Jul  7  1994 930801.0906.n11.s.Z
-rw-rwxr-- 137117 Jul  7  1994 930801.1343.n12.s.Z
-rw-rwxr-- 151550 Jul  7  1994 930801.2026.n11.s.Z
-rw-rwxr-- 178133 Jul  7  1994 930803.1300.n12.s.Z
-rw-rwxr-- 172325 Jul  7  1994 930804.0015.n12.s.Z
-rw-rwxr-- 179689 Jul  7  1994 930804.1010.n11.s.Z
-rw-rwxr-- 142412 Jul  7  1994 930804.1238.n12.s.Z
-rw-rwxr-- 168535 Jul  7  1994 930805.2118.n11.s.Z
-rw-rwxr-- 197241 Jul  7  1994 930806.0946.n11.s.Z
-rw-rwxr-- 163157 Jul  7  1994 930806.2105.n11.s.Z
-rw-rwxr-- 172422 Jul  7  1994 930807.0051.n12.s.Z
-rw-rwxr-- 173980 Jul  7  1994 930807.0933.n11.s.Z
-rw-rwxr-- 159163 Jul  7  1994 930807.1314.n12.s.Z
-rw-rwxr-- 142381 Jul  7  1994 930807.2053.n11.s.Z
-rw-rwxr-- 161712 Jul  7  1994 930808.0029.n12.s.Z
-rw-rwxr-- 146640 Jul  7  1994 930808.0921.n11.s.Z
-rw-rwxr-- 181694 Jul  7  1994 930812.0043.n12.s.Z
-rw-rwxr-- 182444 Jul  7  1994 930812.1013.n11.s.Z
-rw-rwxr-- 181756 Jul  7  1994 930812.1306.n12.s.Z
-rw-rwxr-- 182349 Jul  7  1994 930813.1001.n11.s.Z
-rw-rwxr-- 194124 Jul  7  1994 930814.0949.n11.s.Z
-rw-rwxr-- 212248 Jul  7  1994 930816.0924.n11.s.Z
-rw-rwxr-- 167688 Jul  7  1994 930816.2044.n11.s.Z
-rw-rwxr-- 181736 Jul  7  1994 930817.0036.n12.s.Z
-rw-rwxr-- 178980 Jul  7  1994 930817.0912.n11.s.Z
-rw-rwxr-- 159664 Jul  7  1994 930817.2032.n11.s.Z
-rw-rwxr-- 173839 Jul  7  1994 930818.0014.n12.s.Z
-rw-rwxr-- 166589 Jul  7  1994 930818.0900.n11.s.Z
-rw-rwxr-- 140591 Jul  7  1994 930819.1028.n11.s.Z
-rw-rwxr-- 192081 Jul  7  1994 930820.1016.n11.s.Z
-rw-rwxr-- 219136 Jul  7  1994 930824.0927.n11.s.Z
-rw-rwxr-- 128697 Jul  7  1994 930825.2035.n11.s.Z
-rw-rwxr-- 170570 Jul  7  1994 930826.0903.n11.s.Z
-rw-rwxr-- 181472 Jul  7  1994 930827.0021.n12.s.Z
-rw-rwxr-- 175003 Jul  7  1994 930827.2359.n12.s.Z
-rw-rwxr-- 119371 Jul  7  1994 930828.2338.n12.s.Z
-rw-rwxr-- 172173 Jul  7  1994 930829.1007.n11.s.Z
-rw-rwxr-- 134606 Jul  7  1994 930829.2127.n11.s.Z
-rw-rwxr-- 143462 Jul  7  1994 930830.0057.n12.s.Z
-rw-rwxr-- 212571 Jul  7  1994 930830.0955.n11.s.Z
-rw-rwxr-- 157235 Jul  7  1994 930830.2114.n11.s.Z
-rw-rwxr-- 172253 Jul  7  1994 930831.0035.n12.s.Z
-rw-rwxr-- 198515 Jul  7  1994 930831.0942.n11.s.Z
-rw-rwxr-- 185035 Jul  7  1994 930831.1258.n12.s.Z
-rw-rwxr-- 191169 Jul  7  1994 930831.2102.n11.s.Z
-rw-rwxr--    956 Jul  8  1994 README
-rw-rwxr--   2111 Jul  7  1994 temps

ctd:
total 30
drwxrwxr-x     512 Jan  5 11:11 930527
drwxr-xr-x     512 Feb  1 17:22 930617
drwxrwxr-x     512 Jan  5 11:27 930706
drwxrwxr-x     512 Jan  5 11:32 930709
drwxrwxr-x     512 Jan  5 10:45 930805
drwxrwxr-x     512 Jan  5 09:53 930828
```

```
drwxrwxr-x     512 Jan  5 09:53 930909
drwxrwxr-x     512 Jan  5 09:53 931006
drwxrwxr-x     512 Jan  5 09:53 931129
drwxrwxr-x     512 Jan  5 11:57 940217
drwxrwxr-x     512 Jan  5 12:02 940405
drwxrwxr-x     512 Jan  5 13:04 940428
drwxrwxr-x     512 Jan  5 13:14 940511
drwxrwxr-x     512 Jan  5 13:33 940523
drwxrwxr-x     512 Jan  5 13:39 940526
drwxrwxr-x     512 Jan  5 13:54 940610
drwxrwxr-x     512 Jan  5 14:01 940613
drwxrwxr-x     512 Jan  5 15:38 940622_SB
drwxrwxr-x     512 Jan  5 14:34 940706
drwxrwxr-x    1024 Jan  5 15:46 940708_SB
drwxrwxr-x     512 Jan  5 15:57 940725_SB
drwxrwxr-x     512 Jan  5 16:01 940822_SB
drwxrwxr-x     512 Feb 10 11:01 940824
drwxrwxr-x     512 Jan  6 11:43 940826_SB_AtlC
drwxrwxr-x     512 Jan  5 16:18 940909_SB
drwxrwxr-x     512 Jan  5 16:27 940928_SB
drwxrwxr-x     512 Jan  5 16:34 941025_SB
drwxrwxr-x     512 Jan  5 16:38 941221_SB
drwxr-xr-x     512 Feb  2 12:25 950109
drwxrwxr-x     512 Jan  6 10:31 EXTRAsta09

ctd/930527:
total 7
-rwxrwxr-x   223 Jan  5 11:27 README
-rw-rwxr--  1973 Jan  5 11:09 pd0901.avg.z
-rw-rwxr--  3008 Jan  5 11:10 pd3001.avg.z
-rw-rwxr--   161 Jan  5 11:08 position.dat
   .
   .
   .

ctd/940622_SB:
total 114
-rw-rwxr--   576 Jan  5 15:31 0903d.avg.z
-rw-rwxr--   577 Jan  5 15:38 README
-rw-rwxr-- 20384 Jan  5 15:26 TsecAB.ps.z
-rw-rwxr-- 11865 Jan  5 15:17 Tsection.ps.z
-rw-rwxr--   692 Jan  5 15:31 a101d.avg.z
-rw-rwxr--  1875 Jan  5 15:31 a201d.avg.z
-rw-rwxr--  2437 Jan  5 15:31 a301d.avg.z
-rw-rwxr--  2301 Jan  5 15:31 a401d.avg.z
-rw-rwxr--   858 Jan  5 15:31 ab01d.avg.z
-rw-rwxr--  1993 Jan  5 15:31 b001d.avg.z
-rw-rwxr--  1755 Jan  5 15:32 b101d.avg.z
-rw-rwxr--  2245 Jan  5 15:32 b201d.avg.z
-rw-rwxr--  2134 Jan  5 15:32 b301d.avg.z
-rw-rwxr--  2713 Jan  5 15:32 b401d.avg.z
-rw-rwxr--  3410 Jan  5 15:32 b501d.avg.z
-rw-rwxr-- 52893 Jan  5 15:16 map.ps.z
-rw-rwxr--   601 Jan  5 15:27 position.dat
   .
   .
   .

ctd/EXTRAsta09:          (CTD cruises that consisted of 1 cast, only)
total 10
-rw-rwxr--  2351 Jan  6 10:30 940221.avg.z
-rw-rwxr--  2163 Jan  6 10:30 940325.avg.z
-rw-rwxr--  2266 Jan  6 10:30 940412.avg.z
-rw-rwxr--   235 Jan  6 10:27 README
```

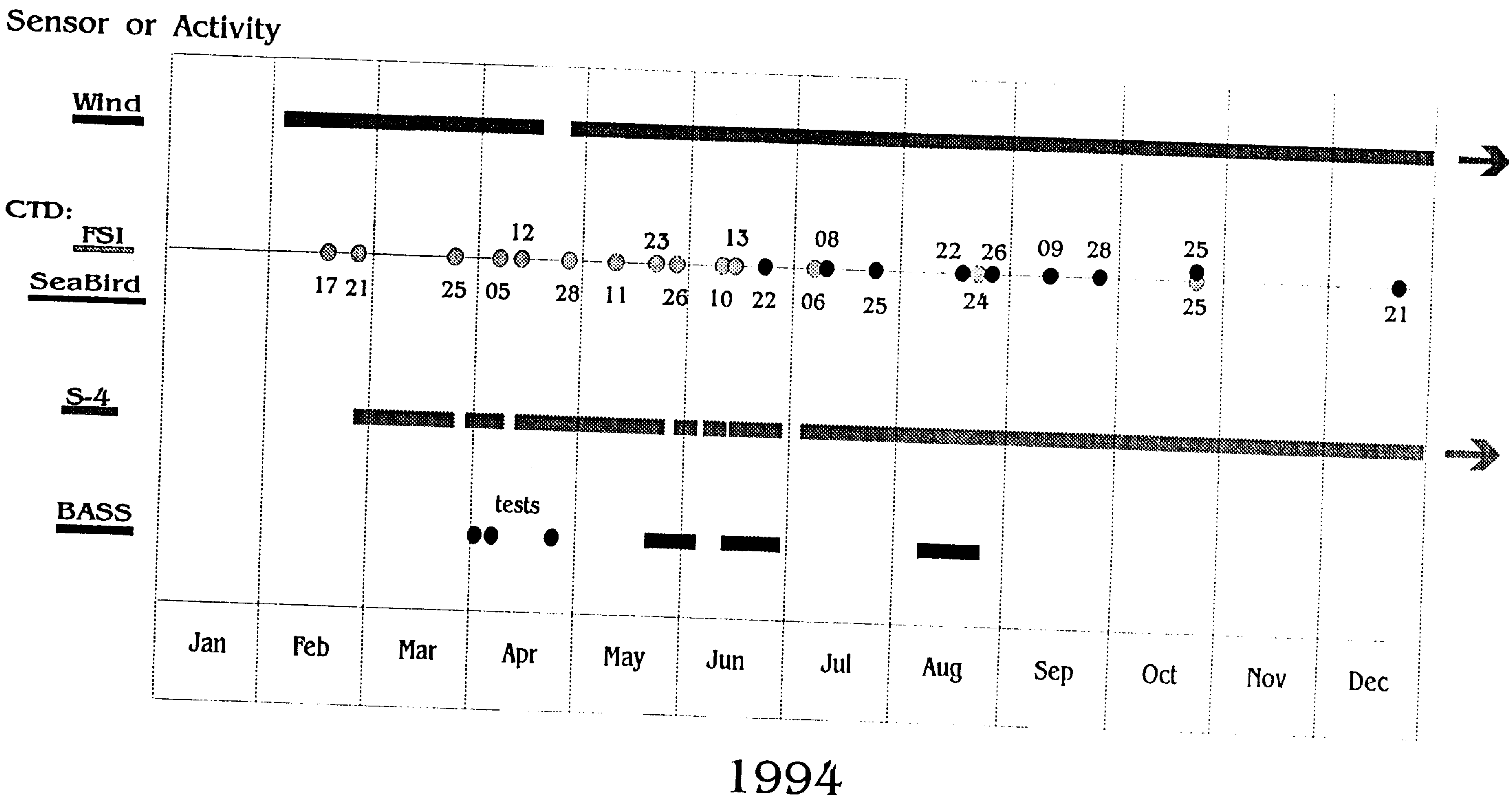
```
s4:                                                        DOY Range
total 980
-rw-r--r-- 21411 Jan  9 18:51 93052630.dat                 135.-146.
-rw-r--r-- 12642 Jan  9 16:37 93080409.dat                 216.-224.
-rw-r--r-- 32708 Jan  9 17:48 93081209.dat                 225.-242.
-rw-r--r-- 66441 Jan  9 18:17 93092009.dat                 263.-273
-rw-r--r-- 51826 Jan  9 18:35 93110309.dat                 307.-334.
-rw-r--r-- 54928 Jan 10 15:57 94022109.dat                 52.- 81.
-rw-r--r-- 19357 Jan 10 16:17 94032509.dat                 84.- 97.
-rw-r--r-- 70470 Jan 11 14:24 94041109.dat                 101.-139.
-rw-r--r--105309 Jan 11 15:48 94051809.dat                 139.-154.
-rw-r--r-- 11378 Jan 11 16:04 94060209.dat                 153.-159.
-rw-r--r--120398 Jan 11 18:21 94060709.dat                 159.-176.
-rw-r--r-- 75842 Jan 11 17:51 94062709.dat                 182.-222.
-rw-r--r-- 87850 Jan 12 11:53 94080909.dat                 222.-268.
-rw-r--r-- 70075 Jan 12 13:30 94100209.dat                 276.-313.
-rw-r--r-- 60595 Jan 12 13:38 94110320.dat                 308.-340.
-rw-r--r--102623 Jan 30 17:16 94111309.dat                 318.-365. (-> 1-7-95)
-rwxrwxr-x   1105 Jan 12 13:53 README

winds:
total 2
drwxr-xr-x     512 Feb 10 12:16 NOAA
drwxr-xr-x     512 Jan 31 17:18 tuckerton

winds/NOAA:
total 490
-rwxrwxr-x  43967 Jul 21  1994 44008fil.dat.Z
-rwxrwxr-x  36071 Jul 21  1994 44009fil.dat.Z
-rwxrwxr-x  60383 Jul 21  1994 44013fil.dat.Z
-rwxrwxr-x  55925 Jul 21  1994 44014fil.dat.Z
-rwxrwxr-x  62261 Jul 21  1994 44025fil.dat.Z
-rwxrwxr-x  60899 Jul 21  1994 alsn6fil.dat.Z
-rwxrwxr-x  60963 Jul 21  1994 buzm3fil.dat.Z
-rwxrwxr-x  60959 Jul 21  1994 chlv2fil.dat.Z
-rwxrwxr-x  55273 Jul 21  1994 dsln7fil.dat.Z
-rwxrwxr-x   1887 Feb 10 12:18 readme.doc

winds/tuckerton:
total 91
-rw-r--r--   685 Jan 31 17:20 README
-rw-r--r-- 92110 Jan 31 16:38 all94.dat.z
```

Operational Periods for Sensors and Measurements at the LEO-15 Site



Coastal Scene Description

Data Analysis, Feature Model and Data Fusion

FY 94 Funding

$0

FY 95 Proposed Funding

$90,000

Accomplishments

New Start

Plans

*Acquire relevant oceanographic and meteorological data from:

- Rutgers Marine Remote Sensing Lab, New Brunswick, NJ
- Rutgers Longterm Ecosystem Observatory, Tuckerton, NJ
- CERC Field Research Facility, Duck, NC
- LWTC, Camp Lejeune, NC
- NOAA Buoys, C-MAN and Tidal Stations.

*Concentrate on data collection starting in 1993, due to availability of satellite imagery.

*Construct GIS with MAB and SAB subregions.

*Use GIS to develop summary descriptions of important events and trends.

LIST OF WIND DATA AVAILABLE FOR 1993 FROM THE REMOTE SENSING LAB AT THE INSTITUTE OF MARINE AND COASTAL SCIENCES, RUTGERS UNIVERSITY*

NOAA buoys:

Station I.D.	Location	Dates Available	Lat / Long
44008	Nantucket	April 15-Dec 31	40.5N / 69.4W
44009	Delaware Bay	June 18-Oct 31	38.5N / 74.7W
44013	Boston	Complete Record	42.4N / 70.7W
44014	Virginia Beach	Complete Record	36.6N / 74.8W
44025	Long Island	Complete Record	40.3N / 73.2W

C-MAN Stations:

Station I.D.	Location	Dates Available	Lat / Long
ALSN6	Ambrose Light	Complete Record	40.5N / 73.8W
BUZM3	Buzzards Bay	Complete Record	41.4N / 71.0W
CHLV2	Chesapeake Light	Complete Record	36.9N / 75.7W
DSLN7	Diamond Shls Lt.	Complete Record	35.2N / 75.3W

Rutger's Marine Field Station at Tuckerton:

A meteorological tower equipped with a wind sensor that measures hourly winds is located at the Tuckerton Field Station. Data collection and archiving is managed by staff employed by the Institute of Marine and Coastal Sciences, Rutgers University.

* Wind measurements include speed and direction in various units, i.e., the NOAA buoy and C-MAN stations record in knots and the Tuckerton wind sensor in m/s. The direction compass is in standard meteorological format (0° indicates winds out of the north and proceeds in a clockwise fashion around to 360°). All clocks are synchronized to Greenwich Mean Time.

```
To access data sets online at the Institute of Marine and
Coastal Sciences, Rutgers University, New Brunswick, New Jersey:


ftp arctic.rutgers.edu           (or, ftp 128.6.141.21)
login: anonymous
password:  use your e-mail address as the password

cd /pub/csd

cd to your desired directory.
say: bin
     prompt
     mget *

If you have any problems, email
laurel@ahab.rutgers.edu
crowley@atlantic.rutgers.edu
styles@arctic.rutgers.edu
  or
glenn@caribbean.rutgers.edu


The following is a listing of all of the sub-directories and
a representative listing of the files available.  File names
are often in the format YYMMDDSt, where YY = year, MM = month,
DD = day, and St = Station.

total 5
-rw-r--r--    193 Feb 13 11:59 README
drwxrwxr-x    512 Jul 20  1994 avhrr
drwxrwxr-x   1024 Feb  2 12:15 ctd
drwxrwxr-x    512 Jan 31 15:40 s4
drwxrwxr-x    512 Feb 10 12:16 winds

avhrr/mab:
total 7196
-rw-rwxr-- 245581 Jul  7  1994 930801.0903.n11.Z
-rw-rwxr-- 193128 Jul  7  1994 930801.2028.n11.Z
-rw-rwxr-- 217525 Jul  7  1994 930802.0851.n11.Z
-rw-rwxr-- 198489 Jul  7  1994 930802.2016.n11.Z
-rw-rwxr-- 217779 Jul  7  1994 930805.2334.n12.Z
-rw-rwxr-- 200489 Jul  7  1994 930809.1228.n12.Z
-rw-rwxr-- 203975 Jul  7  1994 930809.2031.n11.Z
-rw-rwxr-- 235841 Jul  7  1994 930809.2348.n12.Z
-rw-rwxr-- 225759 Jul  7  1994 930810.0854.n11.Z
-rw-rwxr-- 199207 Jul  7  1994 930813.0024.n12.Z
-rw-rwxr-- 219199 Jul  7  1994 930814.0946.n11.Z
-rw-rwxr-- 215153 Jul  7  1994 930815.0934.n11.Z
-rw-rwxr-- 276012 Jul  7  1994 930818.2355.n12.Z
-rw-rwxr-- 231415 Jul  7  1994 930819.0845.n11.Z
-rw-rwxr-- 275382 Jul  7  1994 930819.2333.n12.Z
-rw-rwxr-- 190274 Jul  7  1994 930823.2101.n11.Z
-rw-rwxr-- 252961 Jul  7  1994 930823.2347.n12.Z
-rw-rwxr-- 234035 Jul  7  1994 930824.0925.n11.Z
-rw-rwxr-- 209589 Jul  7  1994 930825.2037.n11.Z
-rw-rwxr-- 194325 Jul  7  1994 930826.0900.n11.Z
-rw-rwxr-- 187283 Jul  7  1994 930826.1303.n12.Z
-rw-rwxr-- 212347 Jul  7  1994 930826.2025.n11.Z
-rw-rwxr-- 164685 Jul  7  1994 930827.0023.n12.Z
-rw-rwxr-- 193721 Jul  7  1994 930827.1241.n12.Z
-rw-rwxr-- 207075 Jul  7  1994 930827.2012.n11.Z
-rw-rwxr-- 189541 Jul  7  1994 930828.0002.n12.Z
-rw-rwxr-- 173239 Jul  7  1994 930828.1016.n11.Z
-rw-rwxr-- 167917 Jul  7  1994 930828.1220.n12.Z
-rw-rwxr-- 152099 Jul  7  1994 930828.2000.n11.Z
```

```
-rw-rwxr-- 182070 Jul  7  1994 930830.0952.n11.Z
-rw-rwxr-- 142523 Jul  7  1994 930830.1317.n12.Z
-rw-rwxr-- 147153 Jul  7  1994 930830.1936.n11.Z
-rw-rwxr-- 167551 Jul  7  1994 930831.0037.n12.Z
-rw-rwxr-- 234767 Jul  7  1994 930831.0940.n11.Z
-rw-rwxr--    762 Jul  7  1994 README
-rw-rwxr--   2111 Jul  7  1994 temps

avhrr/sab:
total 8084
-rw-rwxr-- 196872 Jul  7  1994 930801.0906.n11.s.Z
-rw-rwxr-- 137117 Jul  7  1994 930801.1343.n12.s.Z
-rw-rwxr-- 151550 Jul  7  1994 930801.2026.n11.s.Z
-rw-rwxr-- 178133 Jul  7  1994 930803.1300.n12.s.Z
-rw-rwxr-- 172325 Jul  7  1994 930804.0015.n12.s.Z
-rw-rwxr-- 179689 Jul  7  1994 930804.1010.n11.s.Z
-rw-rwxr-- 142412 Jul  7  1994 930804.1238.n12.s.Z
-rw-rwxr-- 168535 Jul  7  1994 930805.2118.n11.s.Z
-rw-rwxr-- 197241 Jul  7  1994 930806.0946.n11.s.Z
-rw-rwxr-- 163157 Jul  7  1994 930806.2105.n11.s.Z
-rw-rwxr-- 172422 Jul  7  1994 930807.0051.n12.s.Z
-rw-rwxr-- 173980 Jul  7  1994 930807.0933.n11.s.Z
-rw-rwxr-- 158163 Jul  7  1994 930807.1314.n12.s.Z
-rw-rwxr-- 142381 Jul  7  1994 930807.2053.n11.s.Z
-rw-rwxr-- 161712 Jul  7  1994 930808.0029.n12.s.Z
-rw-rwxr-- 146640 Jul  7  1994 930808.0921.n11.s.Z
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-rw-rwxr-- 212248 Jul  7  1994 930816.0924.n11.s.Z
-rw-rwxr-- 167688 Jul  7  1994 930816.2044.n11.s.Z
-rw-rwxr-- 181736 Jul  7  1994 930817.0036.n12.s.Z
-rw-rwxr-- 178980 Jul  7  1994 930817.0912.n11.s.Z
-rw-rwxr-- 159664 Jul  7  1994 930817.2032.n11.s.Z
-rw-rwxr-- 173839 Jul  7  1994 930818.0014.n12.s.Z
-rw-rwxr-- 166589 Jul  7  1994 930818.0900.n11.s.Z
-rw-rwxr-- 140591 Jul  7  1994 930819.1028.n11.s.Z
-rw-rwxr-- 192081 Jul  7  1994 930820.1016.n11.s.Z
-rw-rwxr-- 219136 Jul  7  1994 930824.0927.n11.s.Z
-rw-rwxr-- 128697 Jul  7  1994 930825.2035.n11.s.Z
-rw-rwxr-- 170570 Jul  7  1994 930826.0903.n11.s.Z
-rw-rwxr-- 181472 Jul  7  1994 930827.0021.n12.s.Z
-rw-rwxr-- 175003 Jul  7  1994 930827.2359.n12.s.Z
-rw-rwxr-- 119371 Jul  7  1994 930828.2338.n12.s.Z
-rw-rwxr-- 172173 Jul  7  1994 930829.1007.n11.s.Z
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-rw-rwxr-- 157235 Jul  7  1994 930830.2114.n11.s.Z
-rw-rwxr-- 172253 Jul  7  1994 930831.0035.n12.s.Z
-rw-rwxr-- 198515 Jul  7  1994 930831.0942.n11.s.Z
-rw-rwxr-- 185035 Jul  7  1994 930831.1258.n12.s.Z
-rw-rwxr-- 191169 Jul  7  1994 930831.2102.n11.s.Z
-rw-rwxr--    956 Jul  8  1994 README
-rw-rwxr--   2111 Jul  7  1994 temps

ctd:
total 30
drwxrwxr-x     512 Jan  5 11:11 930527
drwxr-xr-x     512 Feb  1 17:22 930617
drwxrwxr-x     512 Jan  5 11:27 930706
drwxrwxr-x     512 Jan  5 11:32 930709
drwxrwxr-x     512 Jan  5 10:45 930805
drwxrwxr-x     512 Jan  5 09:53 930828
```
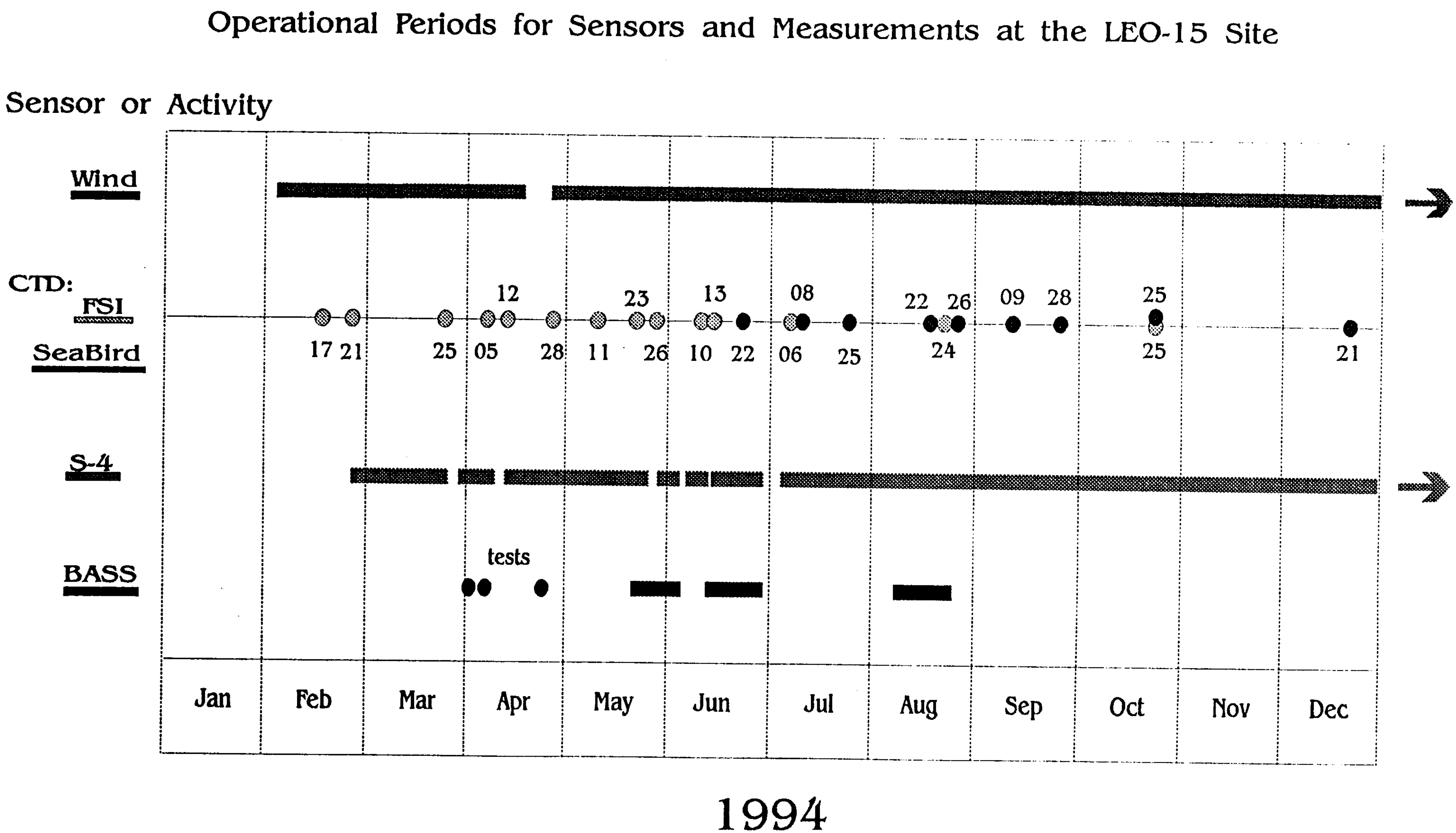

```
drwxrwxr-x     512 Jan  5 09:53 930909
drwxrwxr-x     512 Jan  5 09:53 931006
drwxrwxr-x     512 Jan  5 09:53 931129
drwxrwxr-x     512 Jan  5 11:57 940217
drwxrwxr-x     512 Jan  5 12:02 940405
drwxrwxr-x     512 Jan  5 13:04 940428
drwxrwxr-x     512 Jan  5 13:14 940511
drwxrwxr-x     512 Jan  5 13:33 940523
drwxrwxr-x     512 Jan  5 13:39 940526
drwxrwxr-x     512 Jan  5 13:54 940610
drwxrwxr-x     512 Jan  5 14:01 940613
drwxrwxr-x     512 Jan  5 15:38 940622_SB
drwxrwxr-x     512 Jan  5 14:34 940706
drwxrwxr-x    1024 Jan  5 15:46 940708_SB
drwxrwxr-x     512 Jan  5 15:57 940725_SB
drwxrwxr-x     512 Jan  5 16:01 940822_SB
drwxrwxr-x     512 Feb 10 11:01 940824
drwxrwxr-x     512 Jan  6 11:43 940826_SB_AtlC
drwxrwxr-x     512 Jan  5 16:18 940909_SB
drwxrwxr-x     512 Jan  5 16:27 940928_SB
drwxrwxr-x     512 Jan  5 16:34 941025_SB
drwxrwxr-x     512 Jan  5 16:38 941221_SB
drwxr-xr-x     512 Feb  2 12:25 950109
drwxrwxr-x     512 Jan  6 10:31 EXTRAsta09

ctd/930527:
total 7
-rwxrwxr-x   223 Jan  5 11:27 README
-rw-rwxr--  1973 Jan  5 11:09 pd0901.avg.z
-rw-rwxr--  3008 Jan  5 11:10 pd3001.avg.z
-rw-rwxr--   161 Jan  5 11:08 position.dat
   .
   .
   .

ctd/940622_SB:
total 114
-rw-rwxr--   576 Jan  5 15:31 0903d.avg.z
-rw-rwxr--   577 Jan  5 15:38 README
-rw-rwxr-- 20384 Jan  5 15:26 TsecAB.ps.z
-rw-rwxr-- 11865 Jan  5 15:17 Tsection.ps.z
-rw-rwxr--   692 Jan  5 15:31 a101d.avg.z
-rw-rwxr--  1875 Jan  5 15:31 a201d.avg.z
-rw-rwxr--  2437 Jan  5 15:31 a301d.avg.z
-rw-rwxr--  2301 Jan  5 15:31 a401d.avg.z
-rw-rwxr--   858 Jan  5 15:31 ab01d.avg.z
-rw-rwxr--  1993 Jan  5 15:31 b001d.avg.z
-rw-rwxr--  1755 Jan  5 15:32 b101d.avg.z
-rw-rwxr--  2245 Jan  5 15:32 b201d.avg.z
-rw-rwxr--  2134 Jan  5 15:32 b301d.avg.z
-rw-rwxr--  2713 Jan  5 15:32 b401d.avg.z
-rw-rwxr--  3410 Jan  5 15:32 b501d.avg.z
-rw-rwxr-- 52893 Jan  5 15:16 map.ps.z
-rw-rwxr--   601 Jan  5 15:27 position.dat
   .
   .
   .

ctd/EXTRAsta09:          (CTD cruises that consisted of 1 cast, only)
total 10
-rw-rwxr--  2351 Jan  6 10:30 940221.avg.z
-rw-rwxr--  2163 Jan  6 10:30 940325.avg.z
-rw-rwxr--  2266 Jan  6 10:30 940412.avg.z
-rw-rwxr--   235 Jan  6 10:27 README
```

```
s4:                                                          DOY Range
total 980
-rw-r--r-- 21411 Jan  9 18:51 93052630.dat        135.-146.
-rw-r--r-- 12642 Jan  9 16:37 93080409.dat        216.-224.
-rw-r--r-- 32708 Jan  9 17:48 93081209.dat        225.-242.
-rw-r--r-- 66441 Jan  9 18:17 93092009.dat        263.-273
-rw-r--r-- 51826 Jan  9 18:35 93110309.dat        307.-334.
-rw-r--r-- 54828 Jan 10 15:57 94022109.dat        52.- 81.
-rw-r--r-- 19357 Jan 10 16:17 94032509.dat        84.- 97.
-rw-r--r-- 70470 Jan 11 14:24 94041109.dat        101.-139.
-rw-r--r--105309 Jan 11 15:48 94051809.dat        139.-154.
-rw-r--r-- 11378 Jan 11 16:04 94060209.dat        153.-159.
-rw-r--r--120398 Jan 11 18:21 94060709.dat        159.-176.
-rw-r--r-- 75842 Jan 11 17:51 94062709.dat        182.-222.
-rw-r--r-- 87850 Jan 12 11:53 94080909.dat        222.-268.
-rw-r--r-- 70075 Jan 12 13:30 94100209.dat        276.-313.
-rw-r--r-- 60595 Jan 12 13:38 94110320.dat        308.-340.
-rw-r--r--102623 Jan 30 17:16 94111309.dat        318.-365. (-> 1-7-95)
-rwxrwxr-x   1105 Jan 12 13:53 README

winds:
total 2
drwxr-xr-x     512 Feb 10 12:16 NOAA
drwxr-xr-x     512 Jan 31 17:18 tuckerton

winds/NOAA:
total 490
-rwxrwxr-x  43967 Jul 21  1994 44008fil.dat.Z
-rwxrwxr-x  36071 Jul 21  1994 44009fil.dat.Z
-rwxrwxr-x  60383 Jul 21  1994 44013fil.dat.Z
-rwxrwxr-x  55925 Jul 21  1994 44014fil.dat.Z
-rwxrwxr-x  62261 Jul 21  1994 44025fil.dat.Z
-rwxrwxr-x  60899 Jul 21  1994 alsn6fil.dat.Z
-rwxrwxr-x  60963 Jul 21  1994 buzm3fil.dat.Z
-rwxrwxr-x  60959 Jul 21  1994 chlv2fil.dat.Z
-rwxrwxr-x  55273 Jul 21  1994 dsln7fil.dat.Z
-rwxrwxr-x   1887 Feb 10 12:18 readme.doc

winds/tuckerton:
total 91
-rw-r--r--    685 Jan 31 17:20 README
-rw-r--r-- 92110 Jan 31 16:38 al194.dat.z
```



Operational Periods for Sensors and Measurements at the LEO-15 Site
Sensor or Activity
Wind
CTD:
FSI
SeaBird
S-4
BASS
12
23
13
08
22
26
09
28
25
17 21
25
05
28
11
26
10
22
06
25
24
25
21
tests
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1994

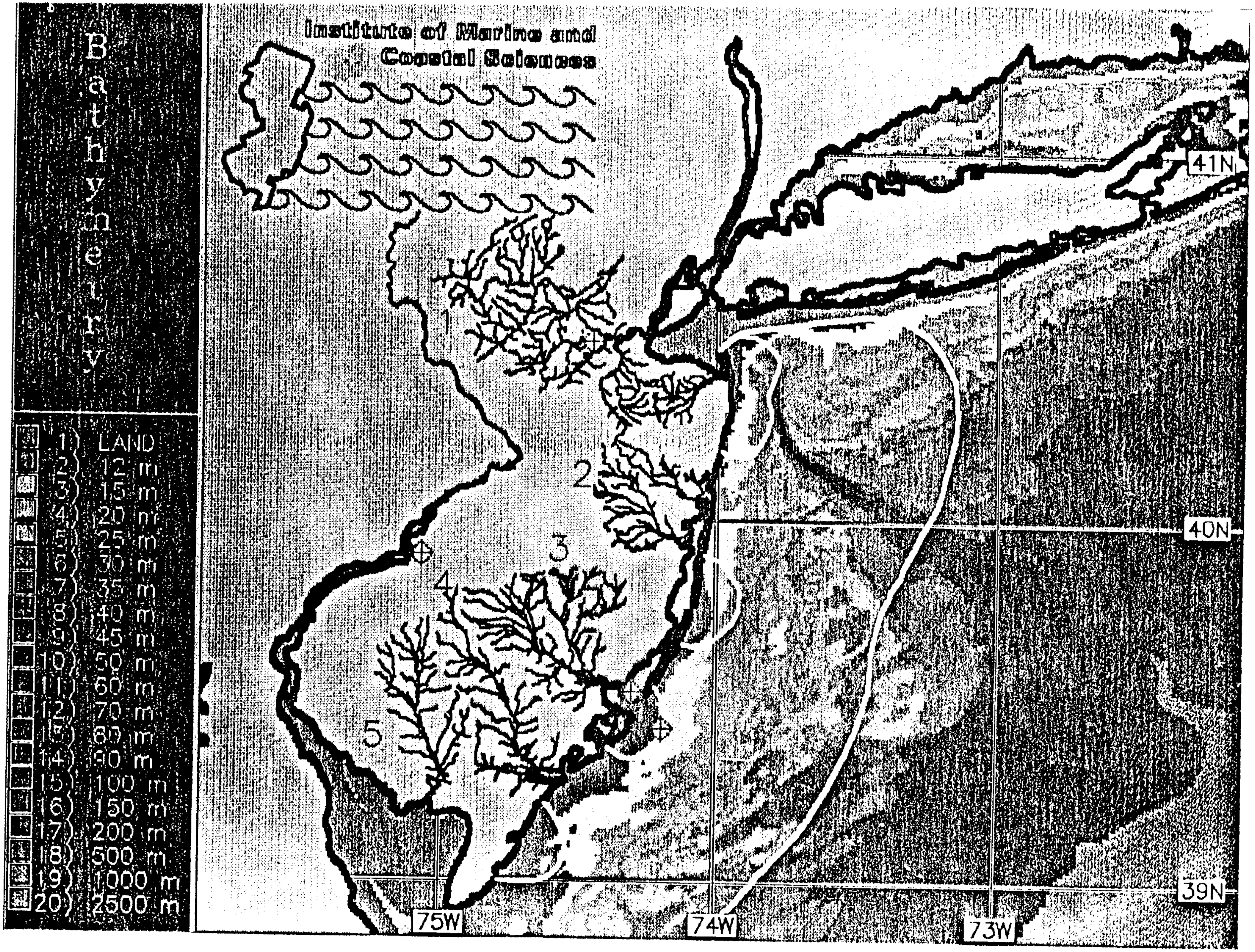
MAB Summer Trends

observed at

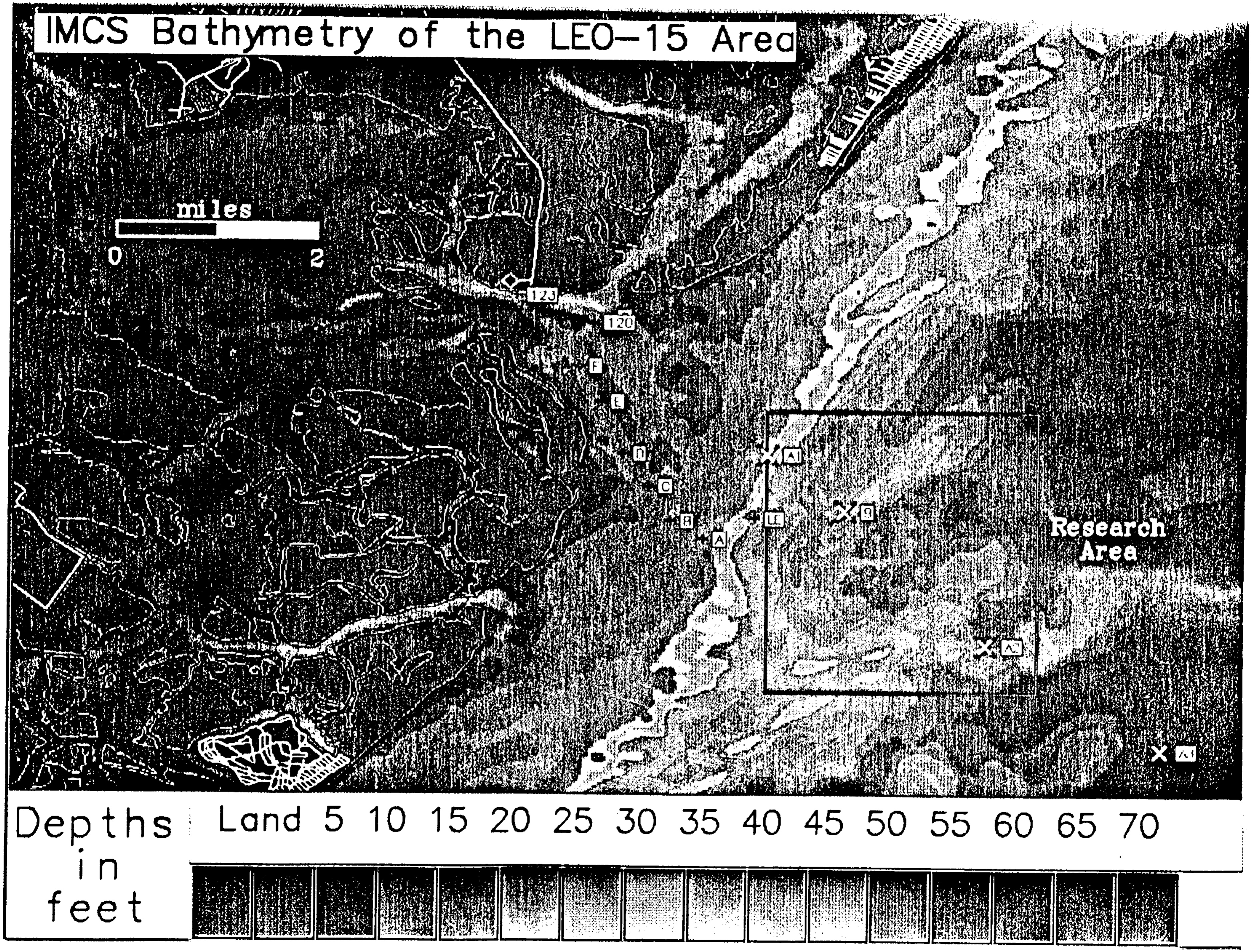
Institute of Marine & Coastal Sciences,
Rutgers University

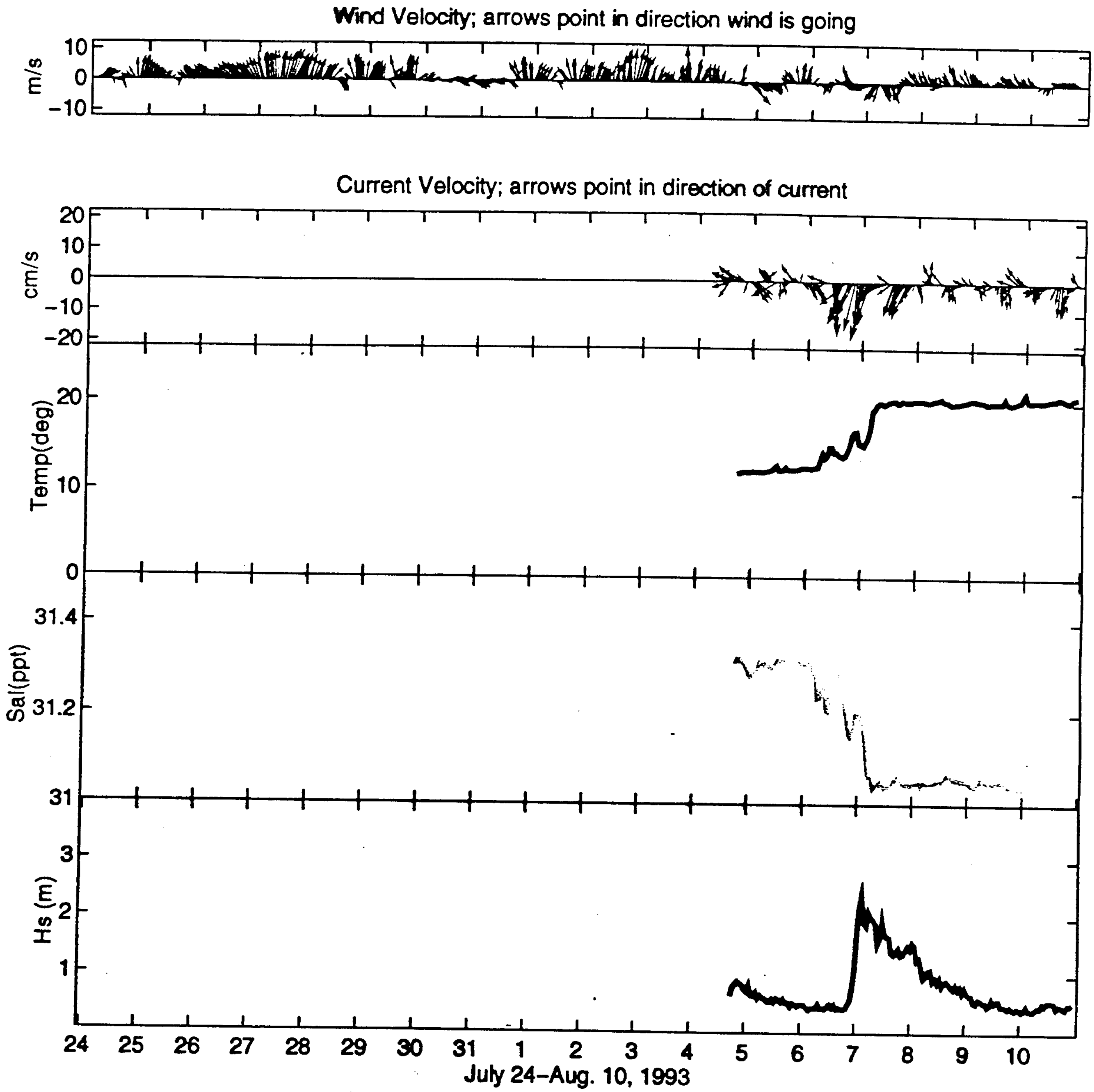
Scott Glenn
Mike Crowley
Laurel Henderson

1)	Clouds
2)	<1.0 C
3)	2.5 C
4)	5.0 C
5)	7.5 C
6)	10.0 C
7)	12.0 C
8)	14.0 C
9)	15.0 C
10)	17.0 C
11)	19.0 C
12)	21.0 C
13)	22.5 C
14)	24.0 C
15)	25.0 C
16)	26.0 C
17)	27.5 C
18)	30.0 C
19)	33.0 C
20)	35.0 C

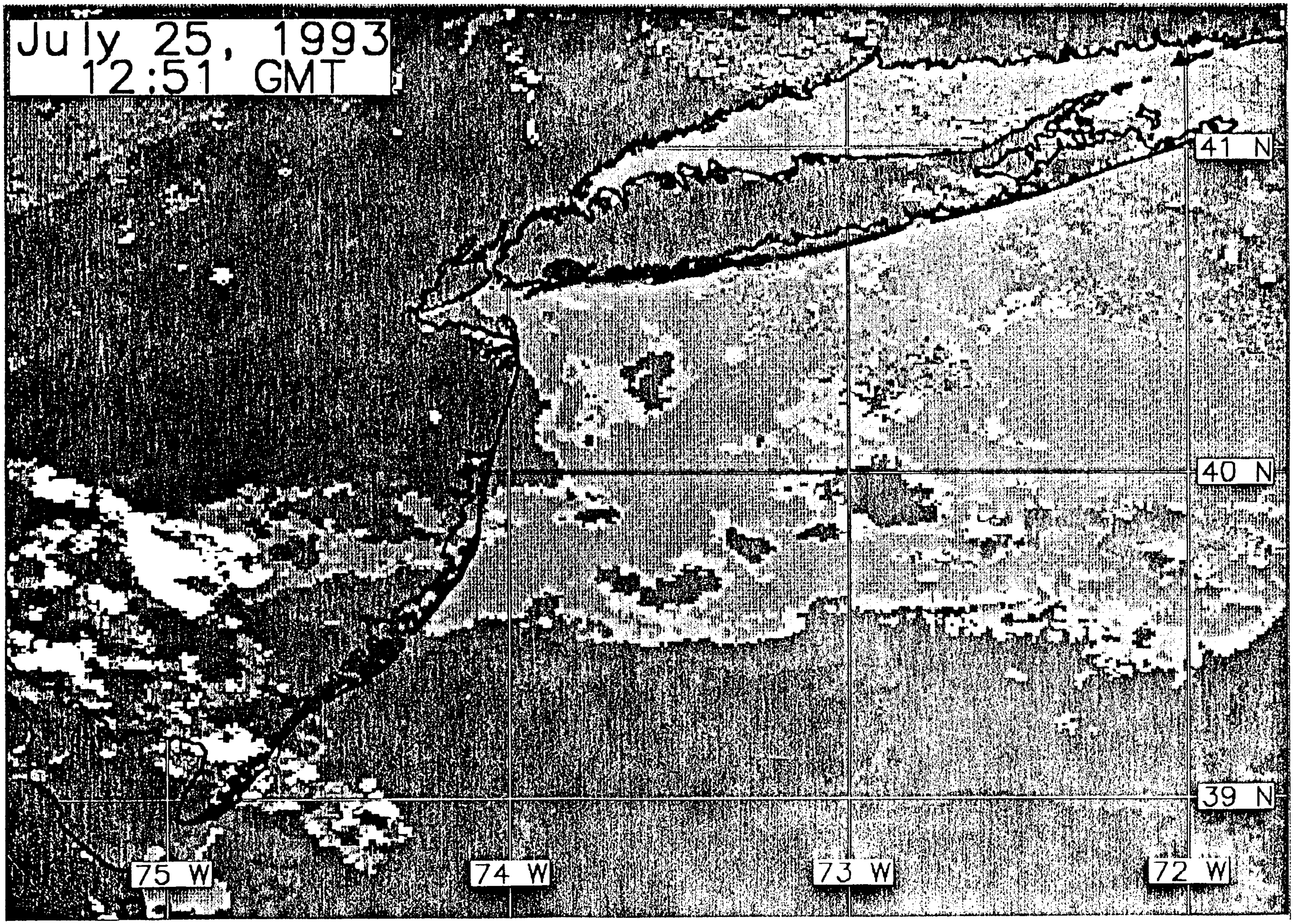


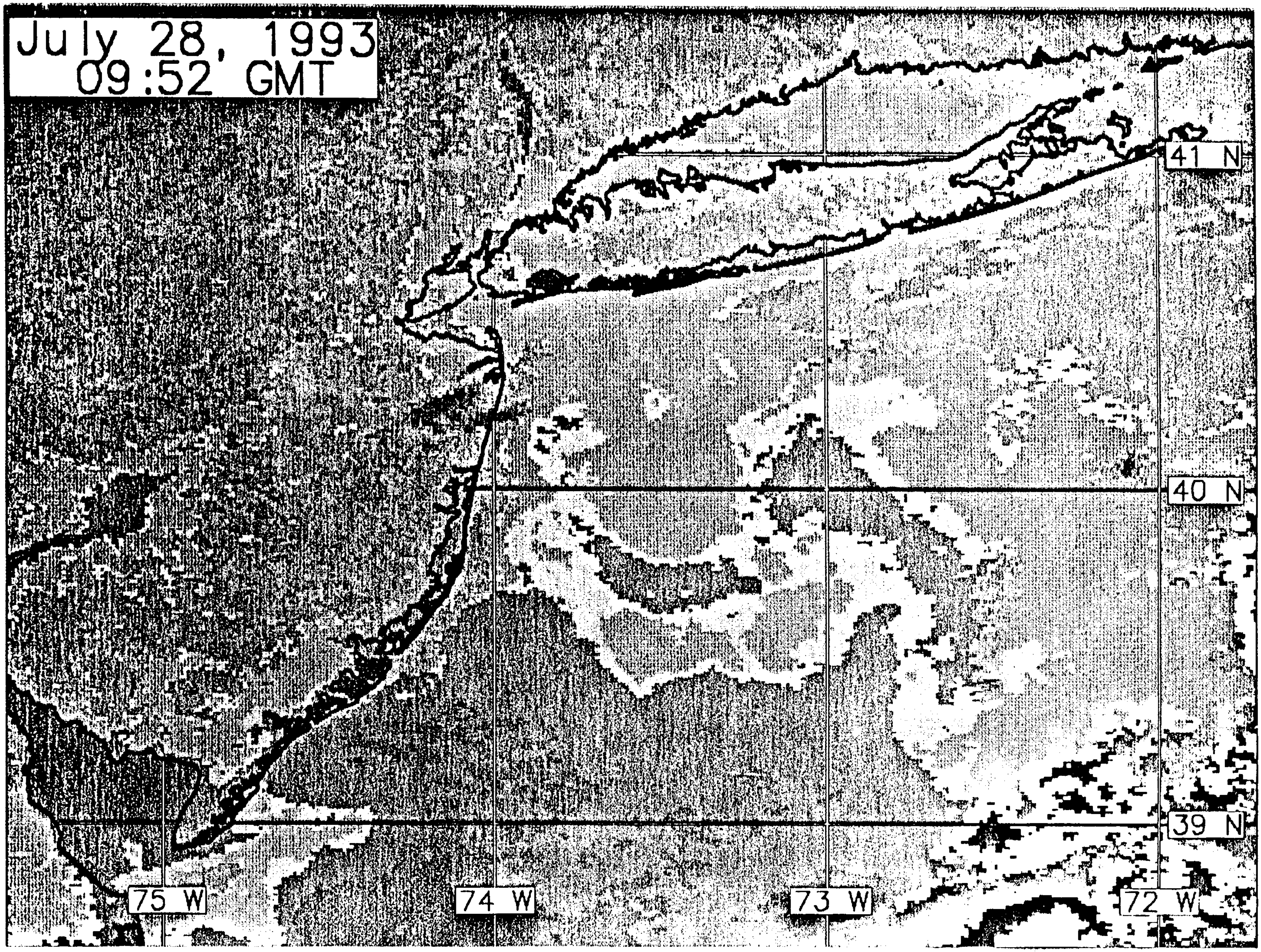
Bathymetry
1) LAND
2) 12 m
3) 15 m
4) 20 m
5) 25 m
6) 30 m
7) 35 m
8) 40 m
9) 45 m
10) 50 m
11) 60 m
12) 70 m
13) 80 m
14) 90 m
15) 100 m
16) 150 m
17) 200 m
18) 500 m
19) 1000 m
20) 2500 m
Institute of Marine and Coastal Sciences
1
2
3
4
5
41N
40N
39N
75W
74W
73W

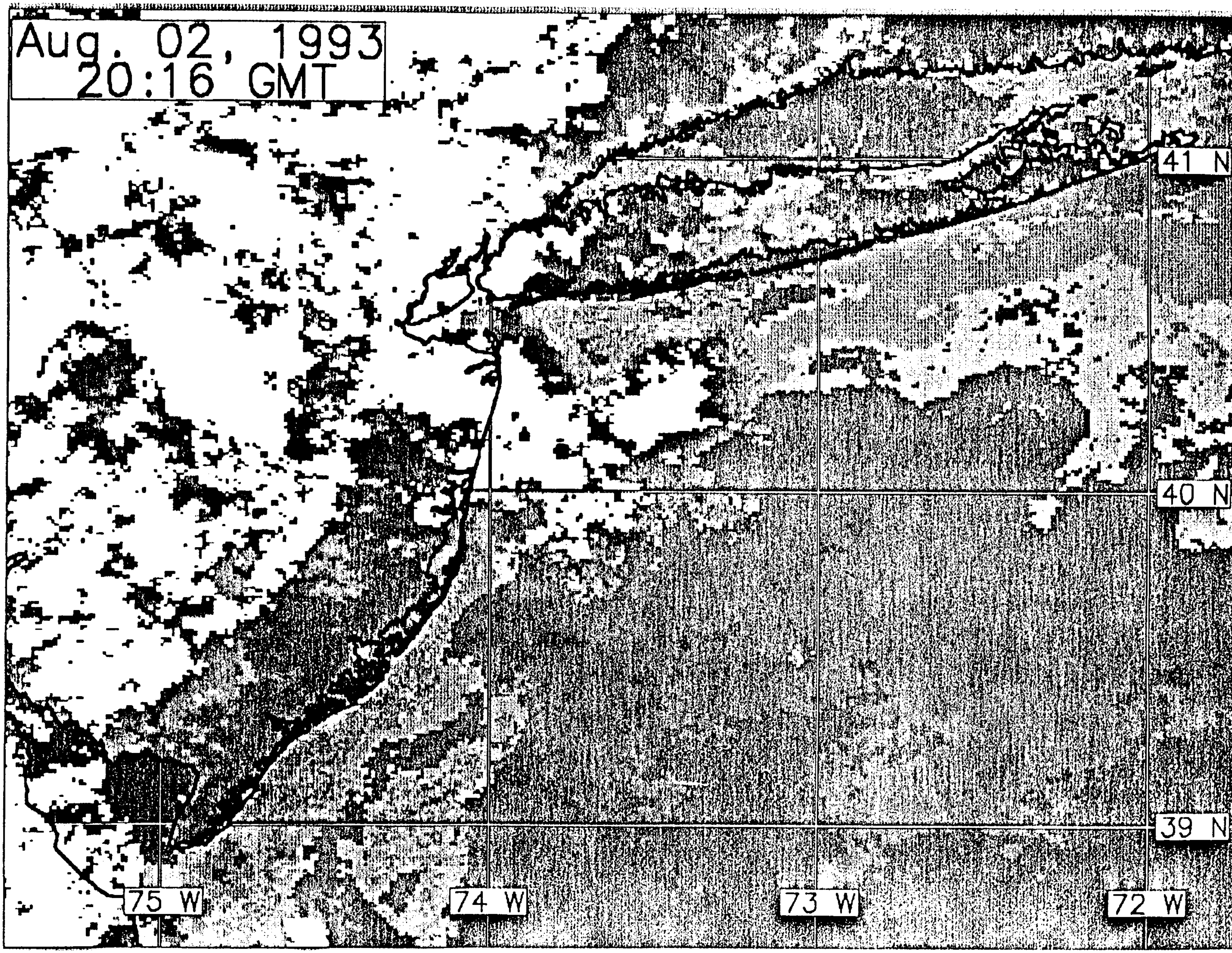

IMCS Bathymetry of the LEO-15 Area
miles
0
2
123
120
F
E
D
C
B
A
Research Area
Depths in feet
Land 5 10 15 20 25 30 35 40 45 50 55 60 65 70

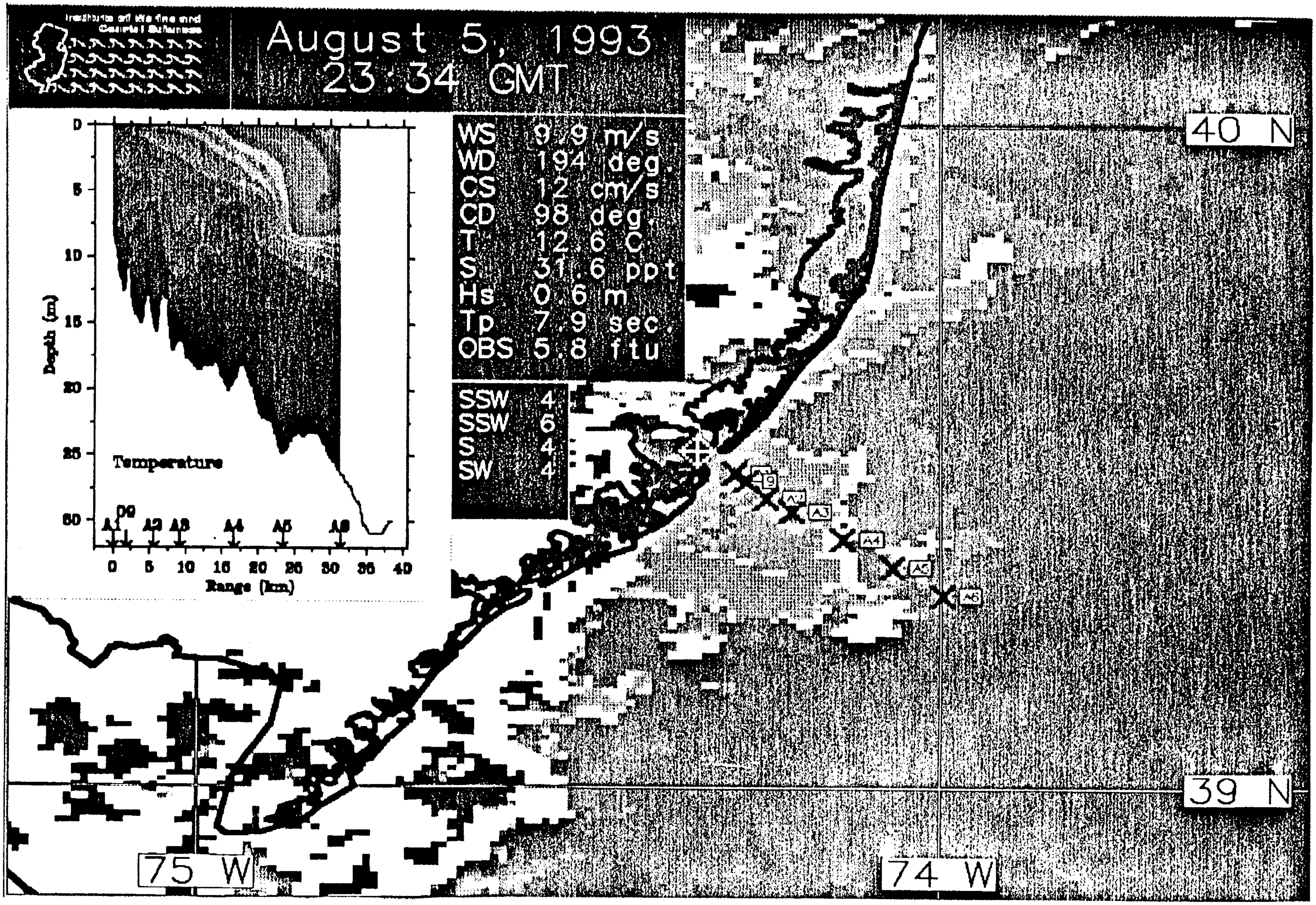


Wind Velocity; arrows point in direction wind is going
m/s
10
0
−10
Current Velocity; arrows point in direction of current
cm/s
20
10
0
−10
−20
Temp(deg)
20
10
0
Sal(ppt)
31.4
31.2
31
Hs (m)
3
2
1
24
25
26
27
28
29
30
31
1
2
3
4
5
6
7
8
9
10
July 24–Aug. 10, 1993

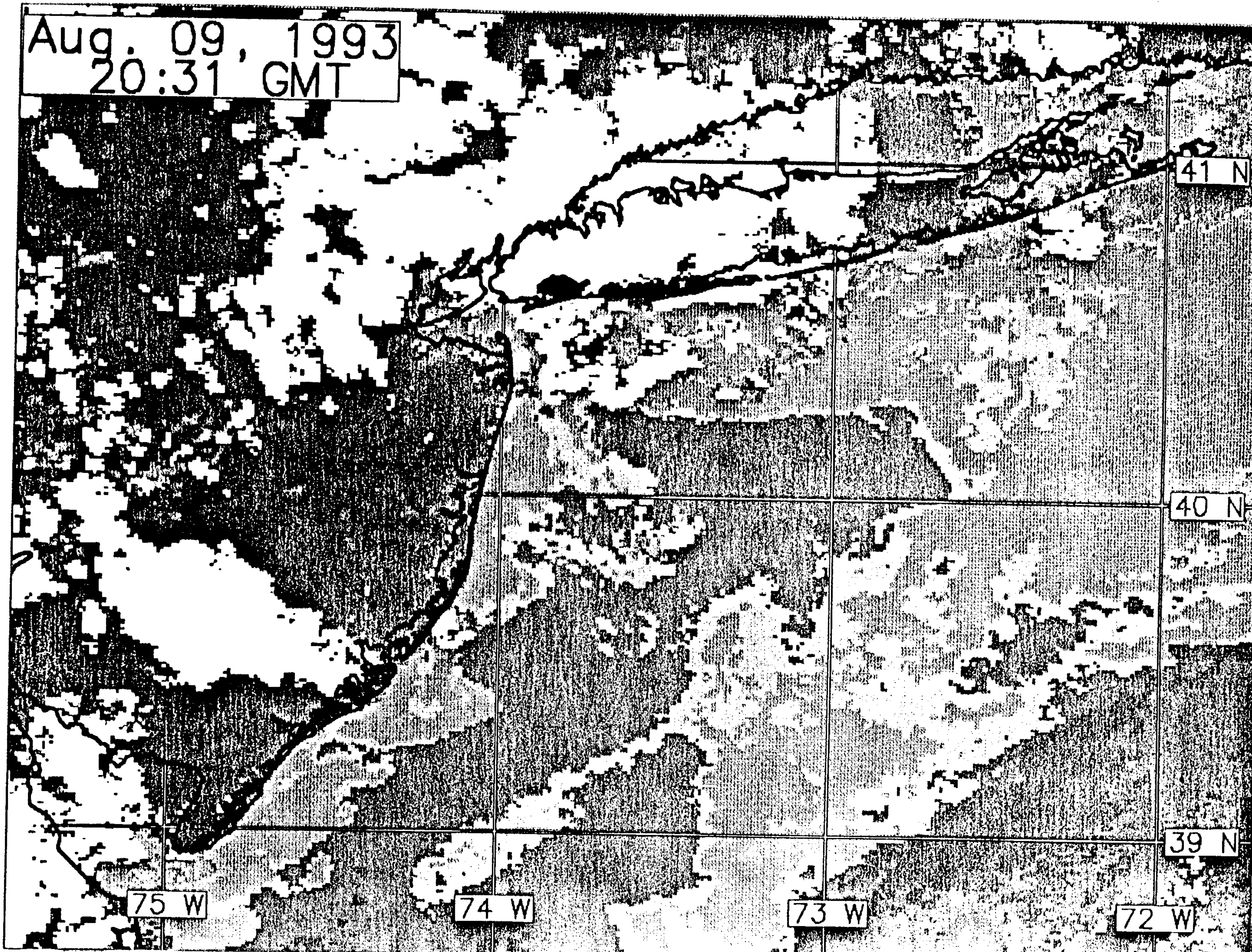

July 25, 1993
12:51 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W


July 28, 1993
09:52 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W

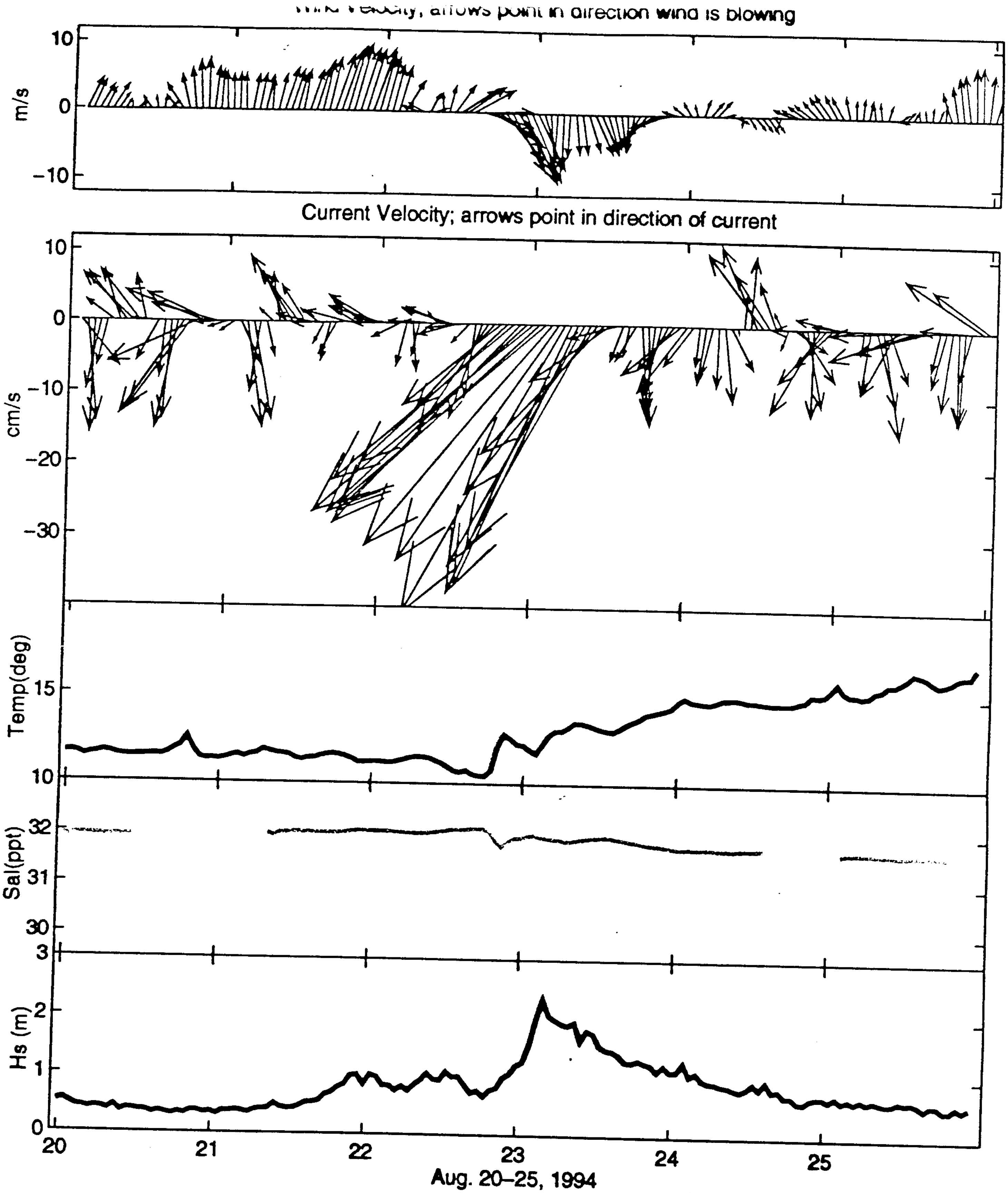

Aug. 02, 1993
20:16 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W

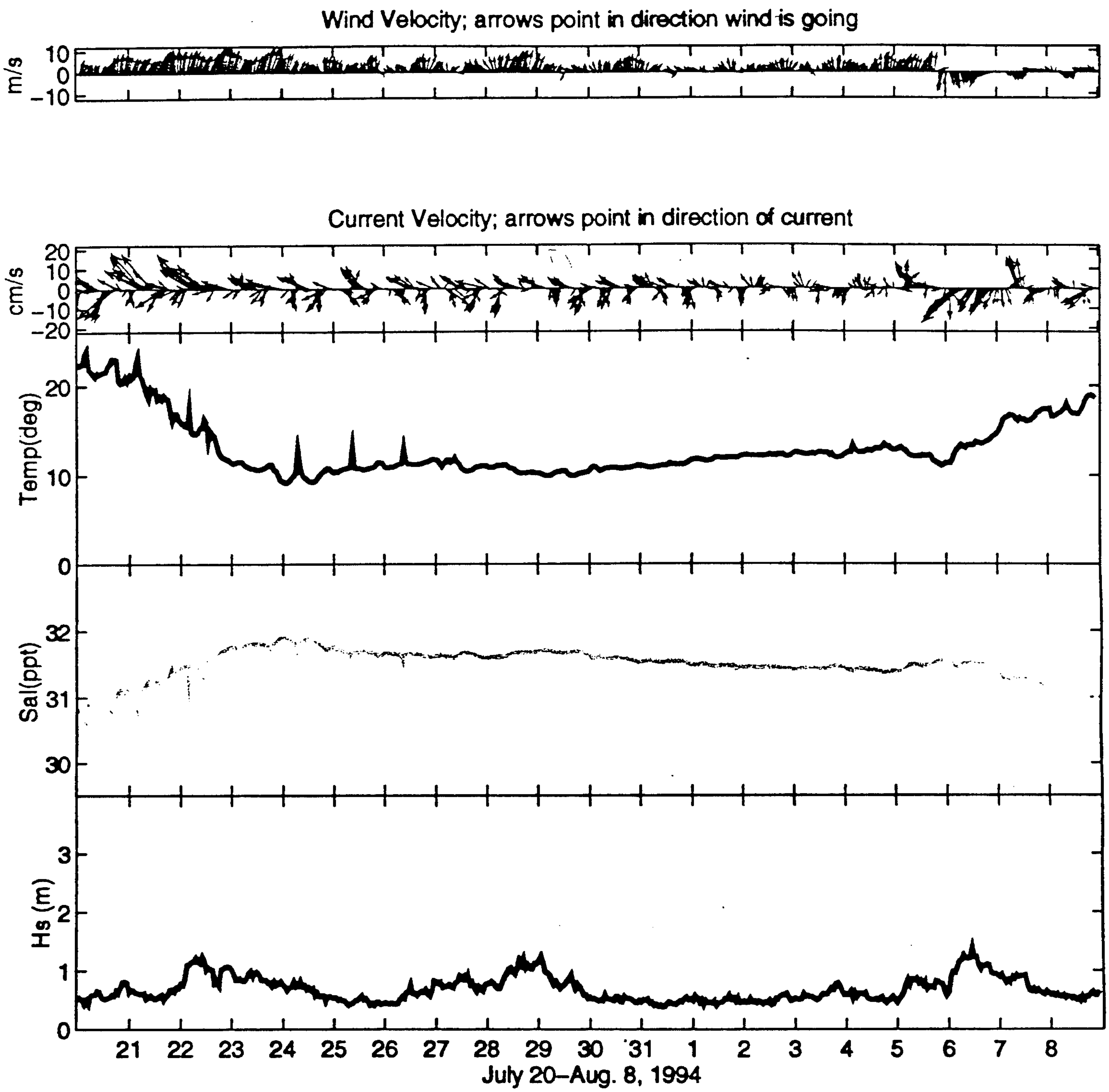


Institute of Marine and Coastal Sciences
August 5, 1993
23:34 GMT
WS 9.9 m/s
WD 194 deg.
CS 12 cm/s
CD 98 deg.
T 12.6 C
S 31.6 ppt
Hs 0.6 m
Tp 7.9 sec.
OBS 5.8 ftu
SSW 4
SSW 6
S 4
SW 4
Temperature
Depth (m)
Range (km)
0 5 10 15 20 25 30 35 40
A1 D9 A2 A3 A4 A5 A6
40 N
39 N
75 W
74 W
A2
A3
A4
A5
A6

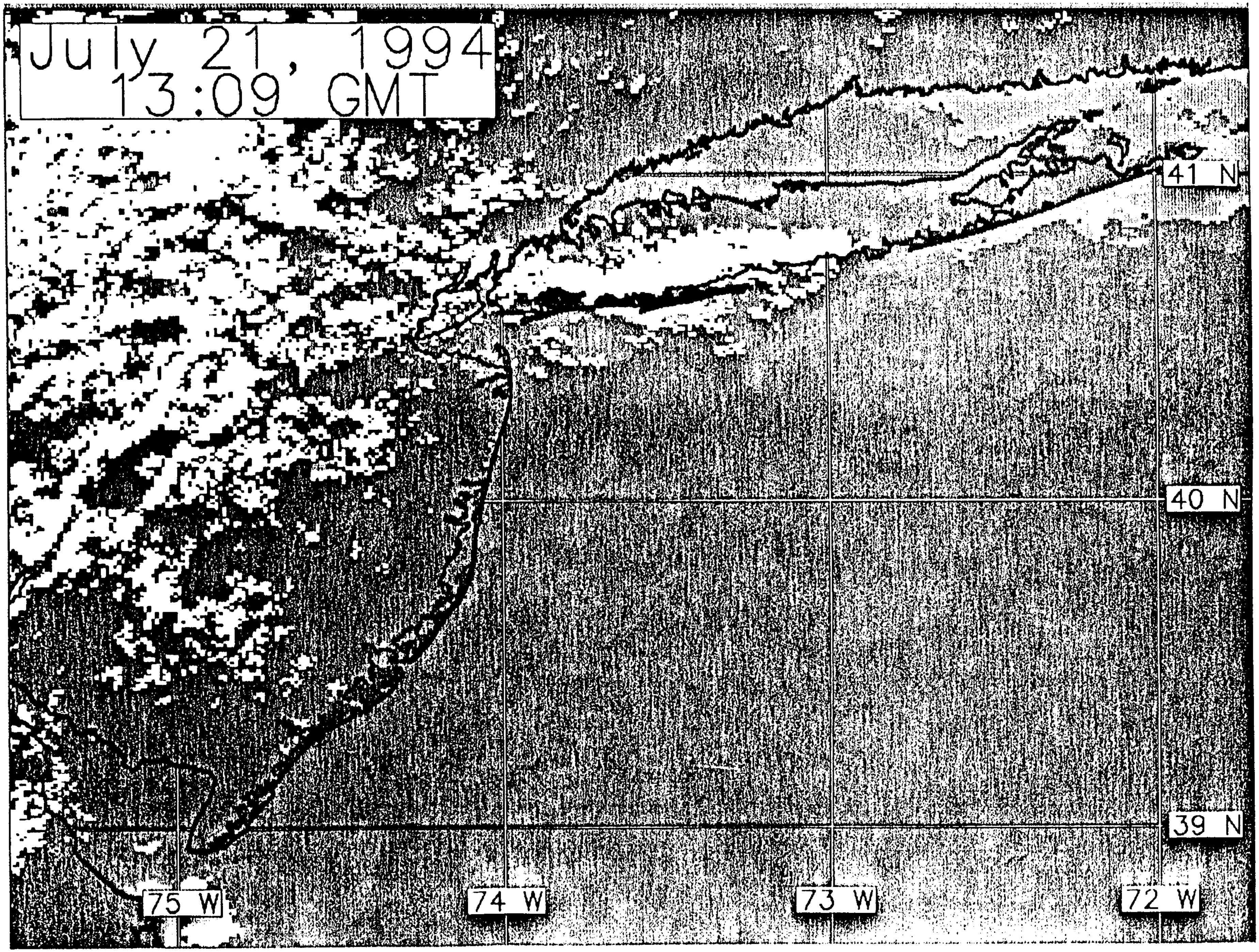


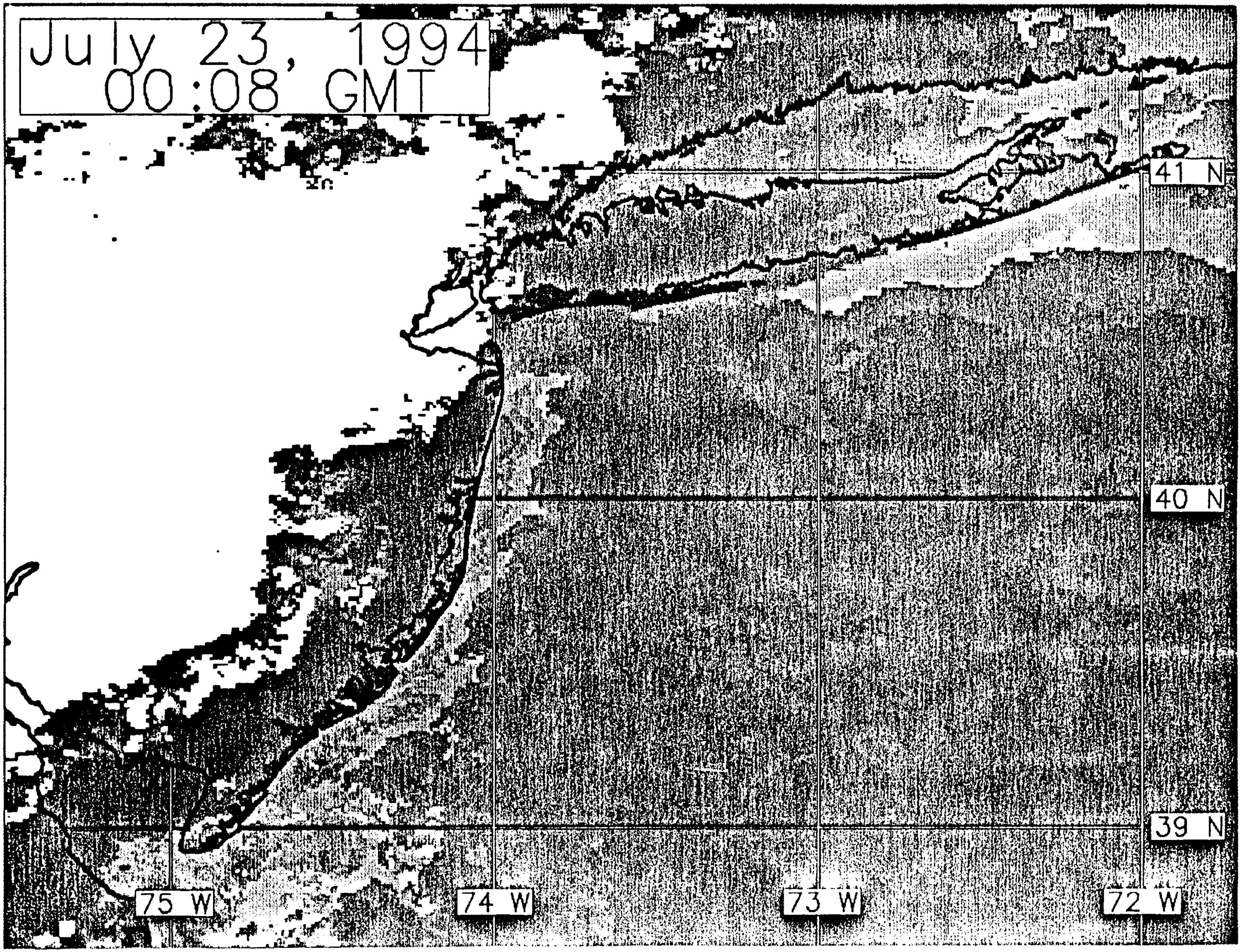
Aug. 09, 1993
20:31 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W

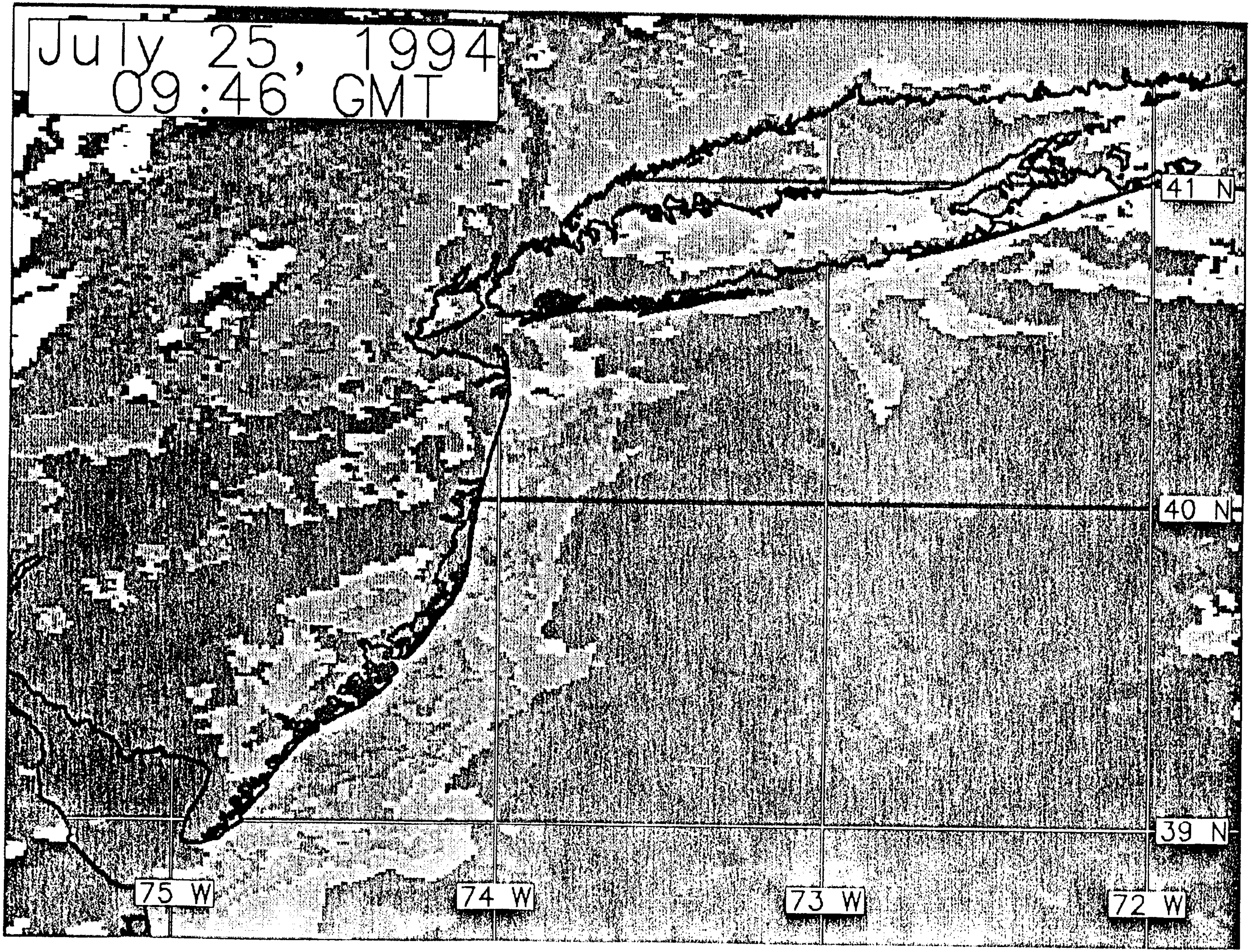

arrows point in direction wind is blowing
m/s
10
0
−10
Current Velocity; arrows point in direction of current
cm/s
10
0
−10
−20
−30
Temp(deg)
15
10
Sal(ppt)
32
31
30
3
Hs (m)
2
1
0
20
21
22
23
24
25
Aug. 20–25, 1994



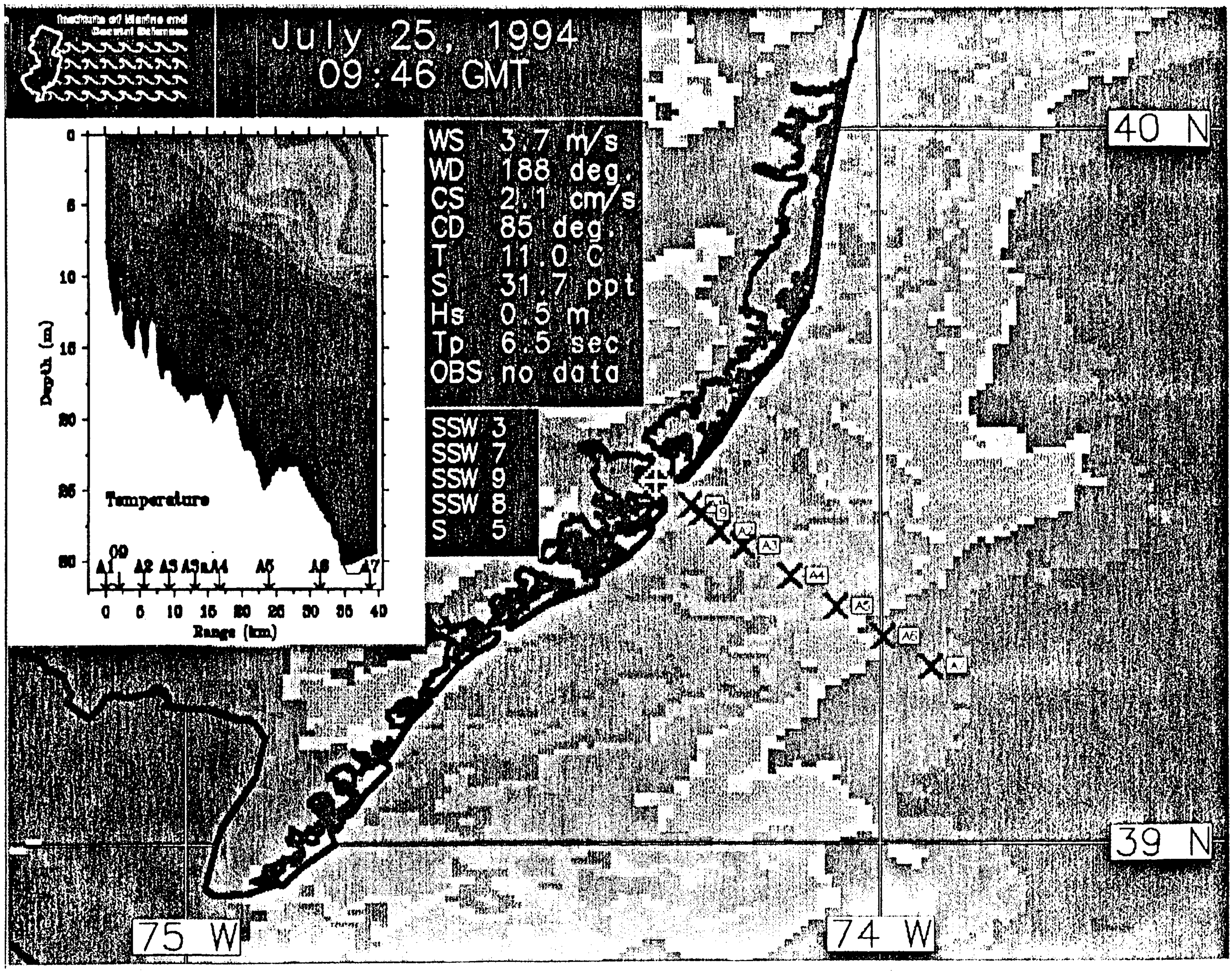
Wind Velocity; arrows point in direction wind is going
m/s
10
0
−10
Current Velocity; arrows point in direction of current
cm/s
20
10
0
−10
−20
Temp(deg)
20
10
0
Sal(ppt)
32
31
30
Hs (m)
3
2
1
0
21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
July 20–Aug. 8, 1994

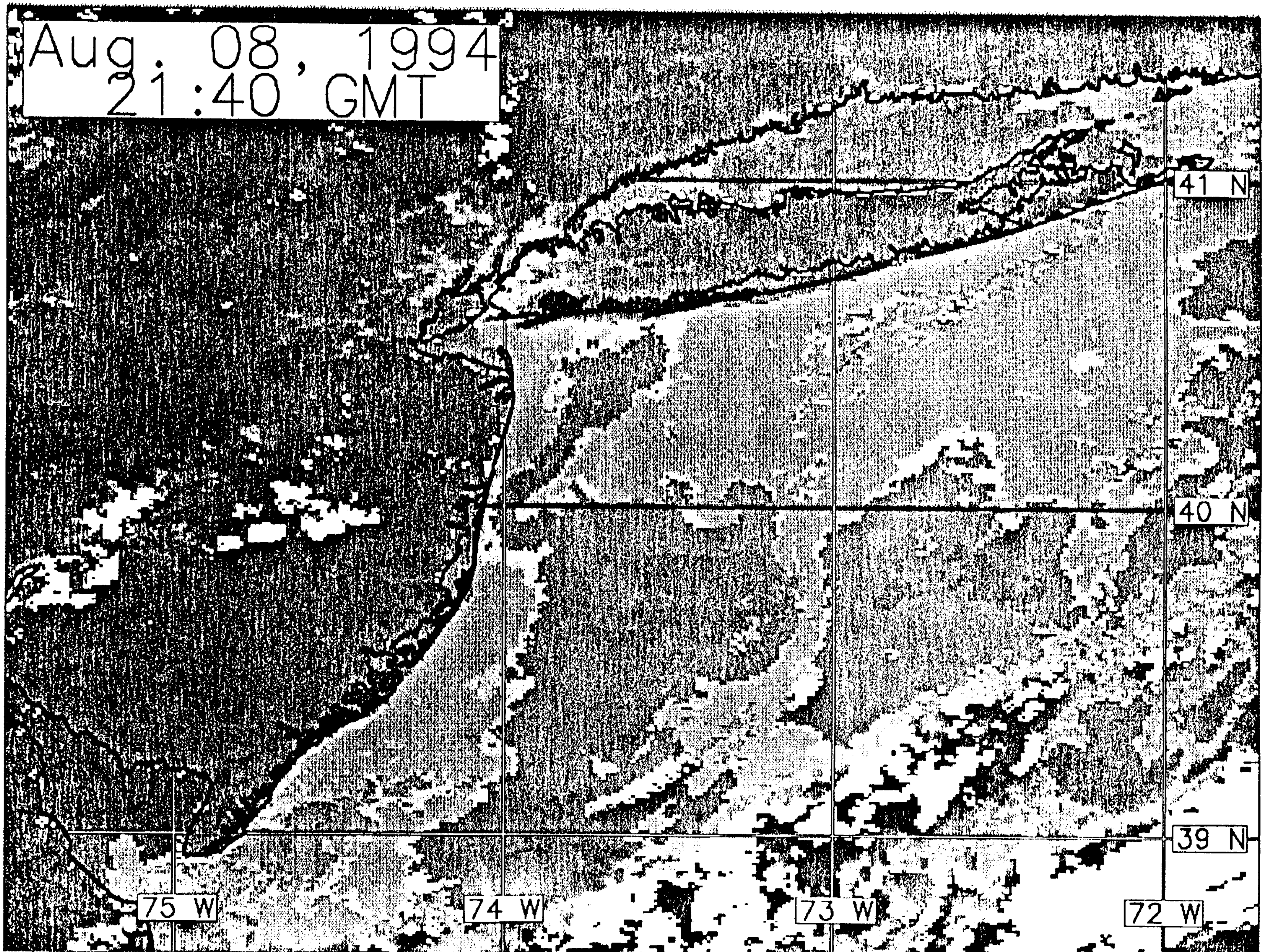

July 21, 1994
13:09' GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W

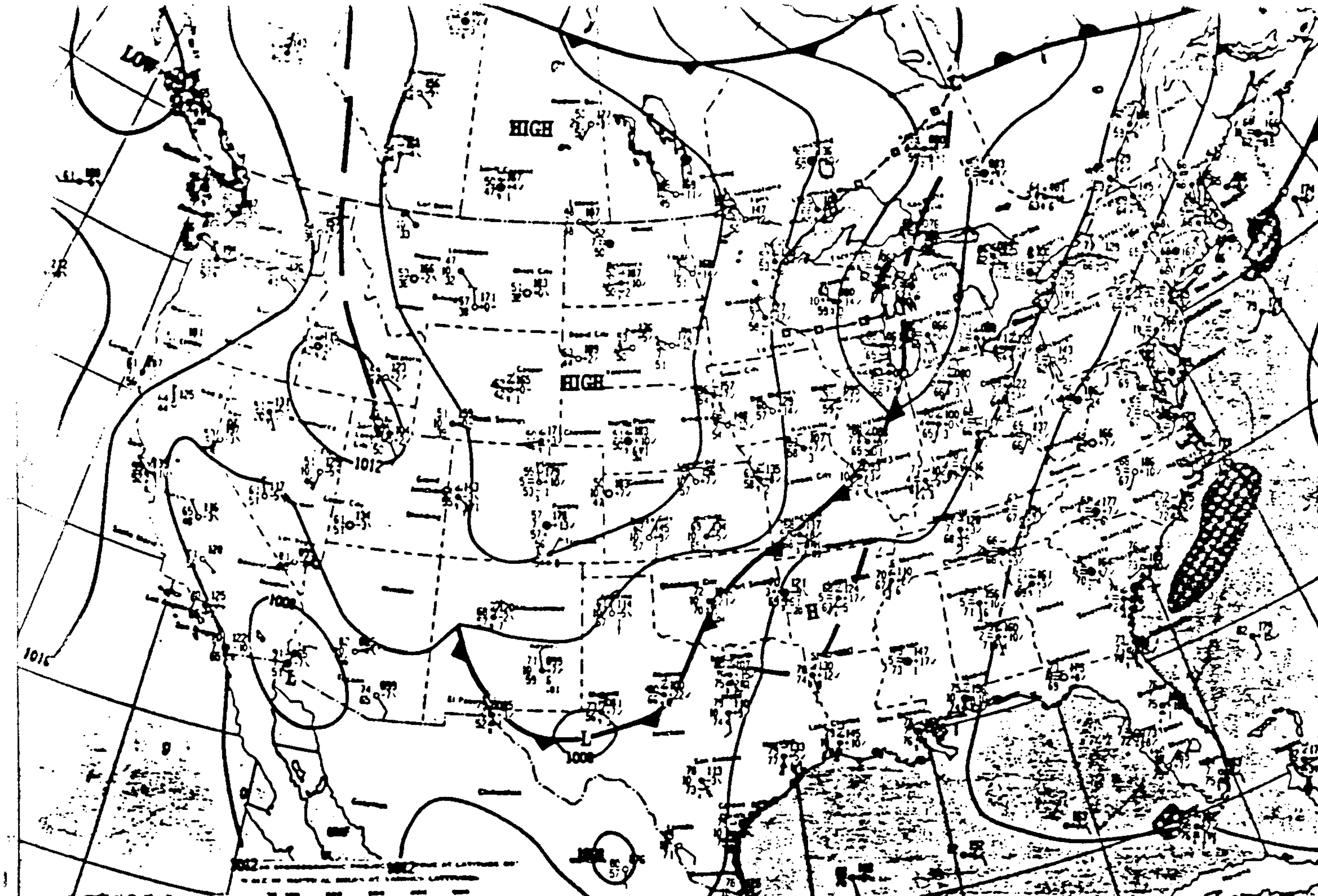

July 23, 1994
00:08 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W



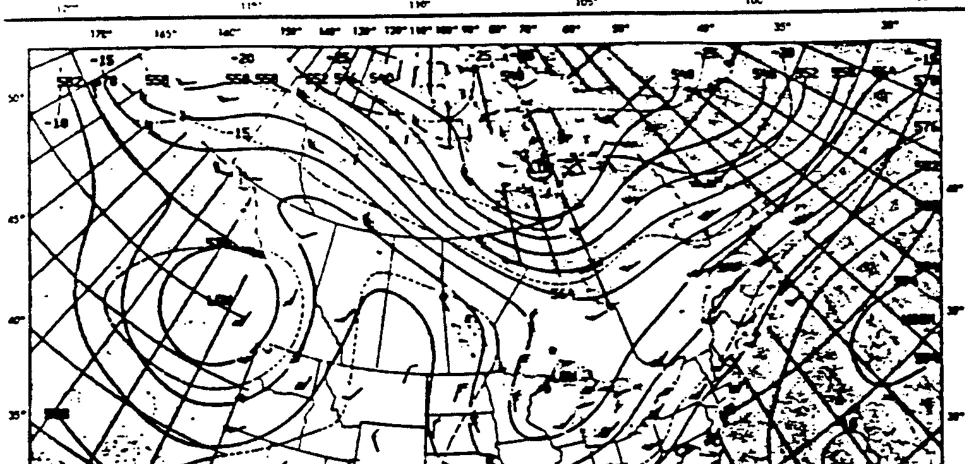
July 25, 1994
09:46 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W


Institute of Marine and Coastal Sciences
July 25, 1994
09:46 GMT
WS 3.7 m/s
WD 188 deg.
CS 2.1 cm/s
CD 85 deg.
T 11.0 C
S 31.7 ppt
Hs 0.5 m
Tp 6.5 sec
OBS no data
SSW 3
SSW 7
SSW 9
SSW 8
S 5
Temperature
Depth (m)
Range (km)
A1 A2 A3 A4 A5 A6 A7
40 N
39 N
75 W
74 W

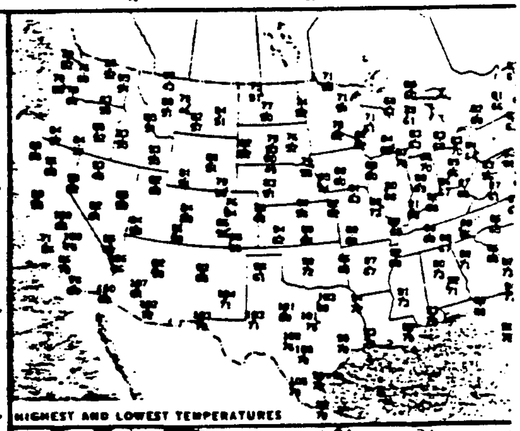

Aug. 08, 1994
21:40 GMT
41 N
40 N
39 N
75 W
74 W
73 W
72 W



SURFACE WEATHER MAP AND STATION WEATHER AT 7:00 A.M. E.S.T.

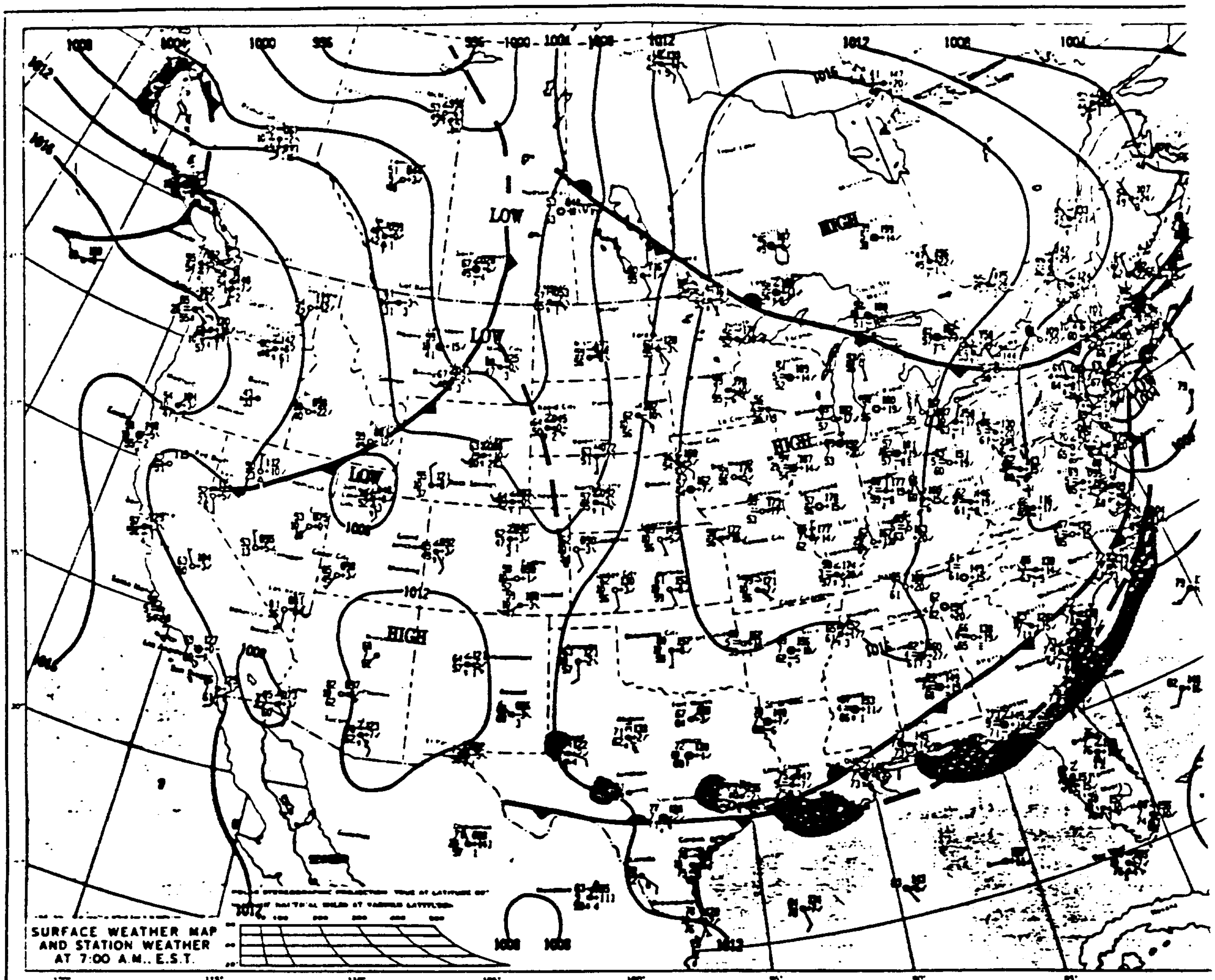


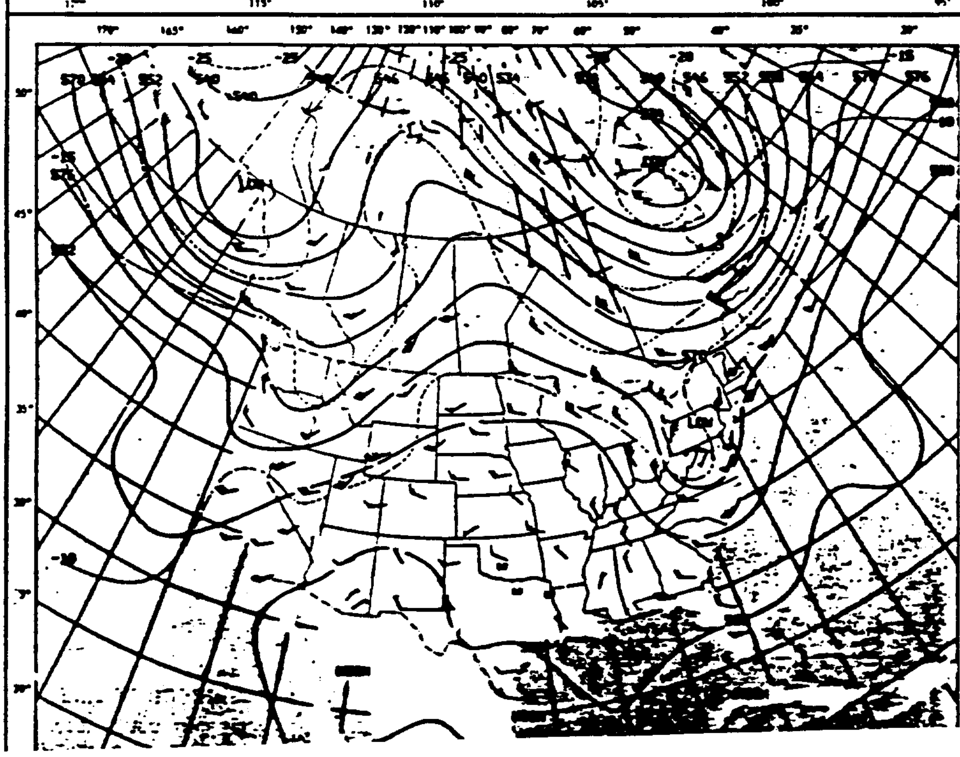
500-MILLIBAR HEIGHT CONTOURS AT 7:00 A.M., E.S.T.

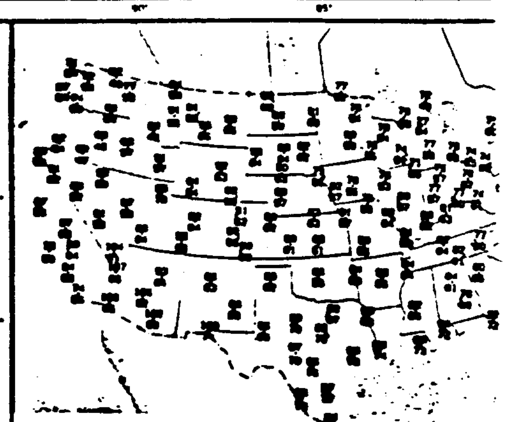

HIGHEST AND LOWEST TEMPERATURES

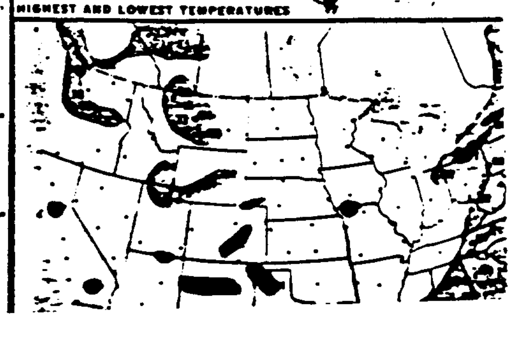

PRECIPITATION AREAS AND AMOUNTS

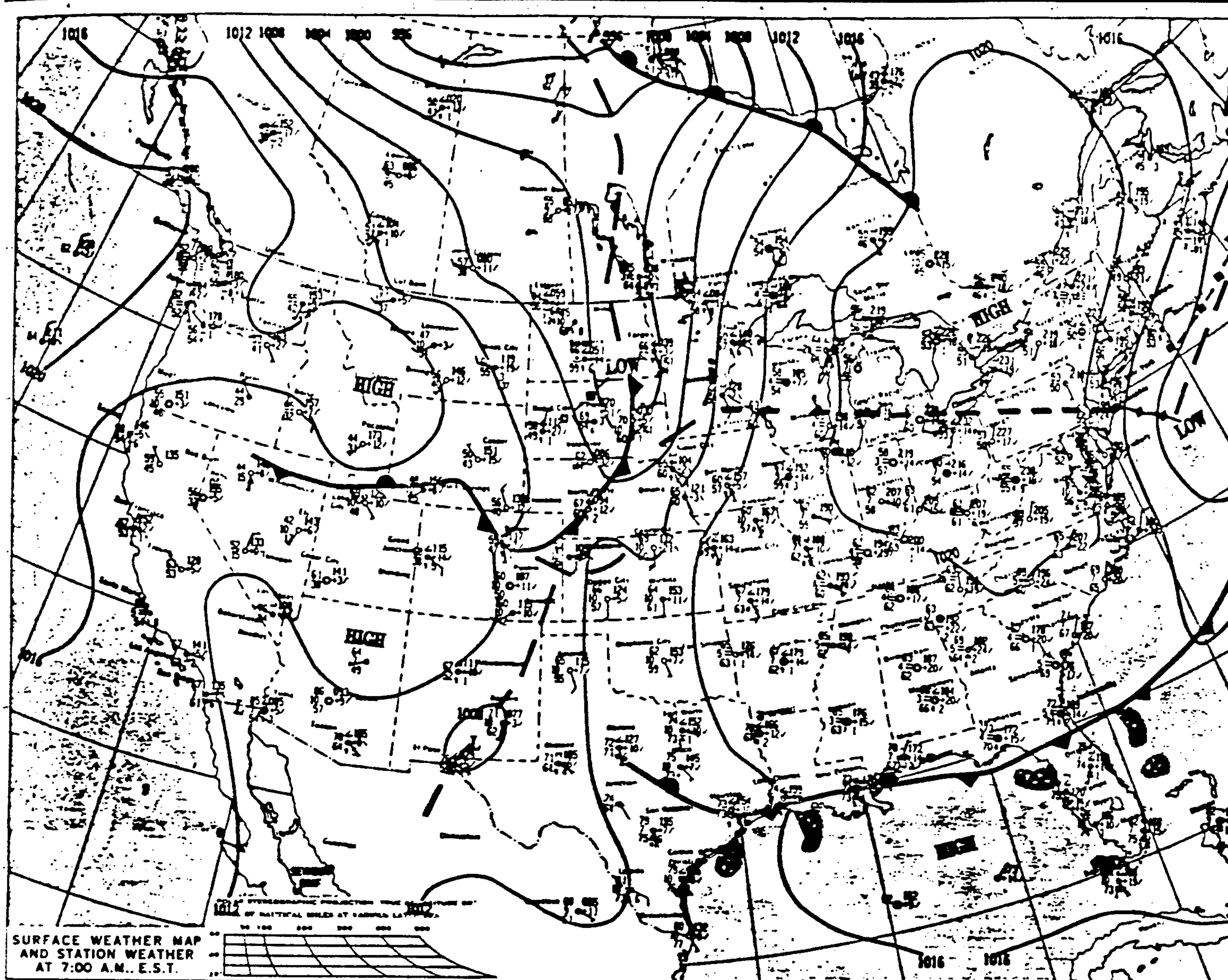
MONDAY, AUGUST 22, 1994

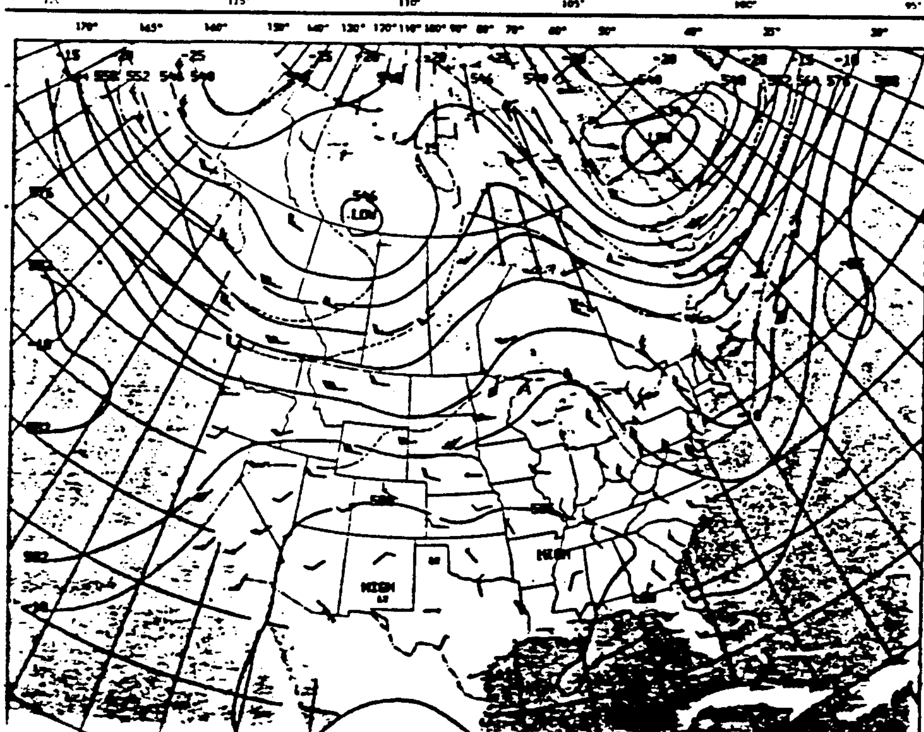


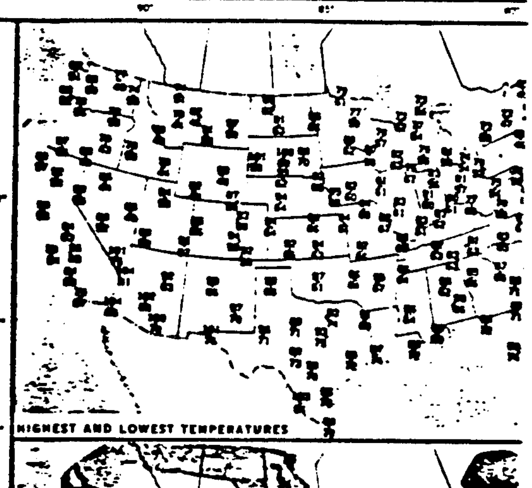




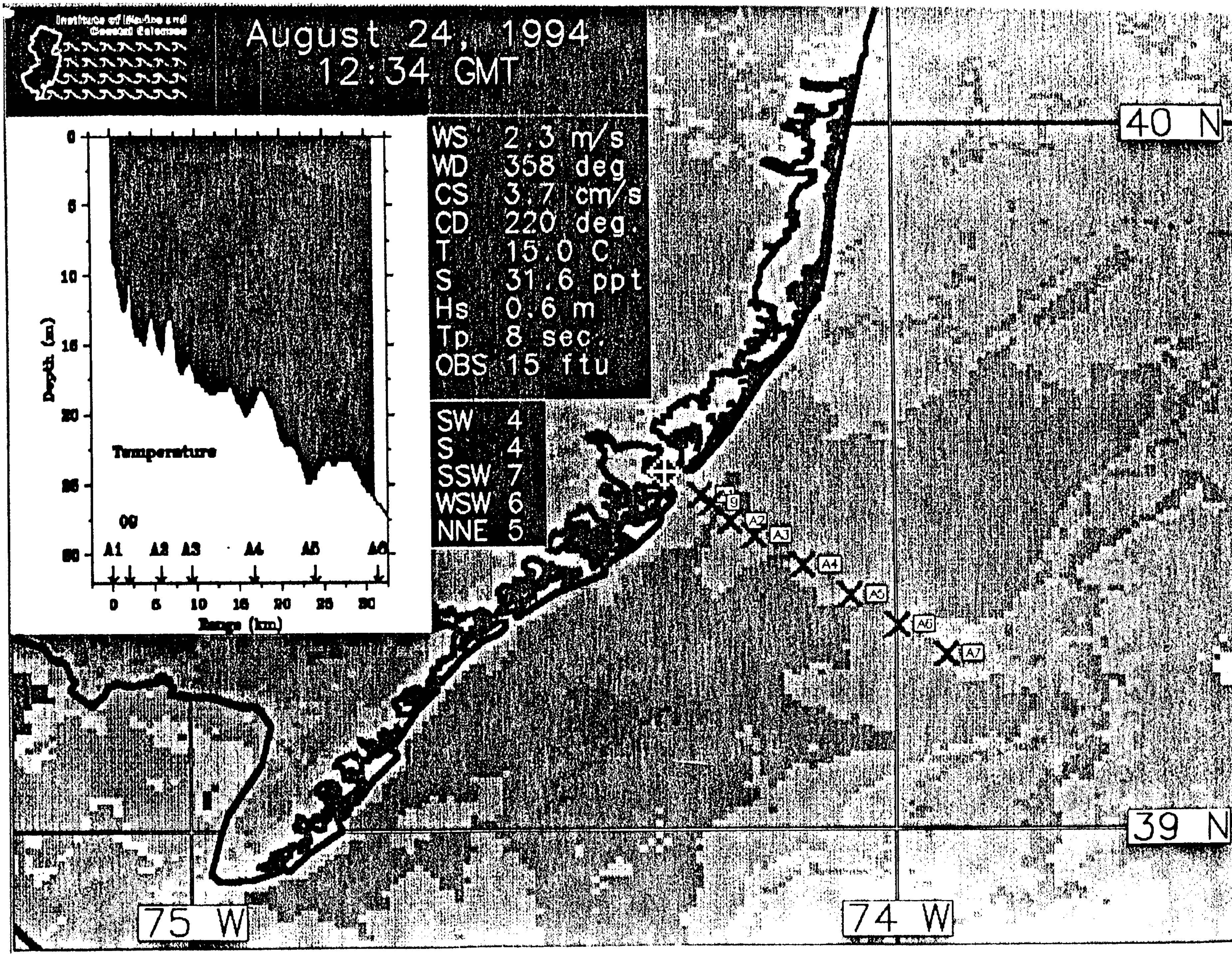








HIGHEST AND LOWEST TEMPERATURES



Institute of Marine and Coastal Sciences
August 24, 1994
12:34 GMT
WS 2.3 m/s
WD 358 deg
CS 3.7 cm/s
CD 220 deg.
T 15.0 C
S 31.6 ppt
Hs 0.6 m
Tp 8 sec.
OBS 15 ftu
SW 4
S 4
SSW 7
WSW 6
NNE 5
Temperature
Depth (m)
Range (km)
A1 A2 A3 A4 A5 A6 A7
40 N
39 N
75 W
74 W

Coastal Scene Description

Ocean Expert System

Amphibious Assault Scene Description Status

Stephen A. Mack
Lien T. Duong
David J. Scheerer

CSD Mini-Workshop
APL/UW
Seattle, Washington

14 February, 1995

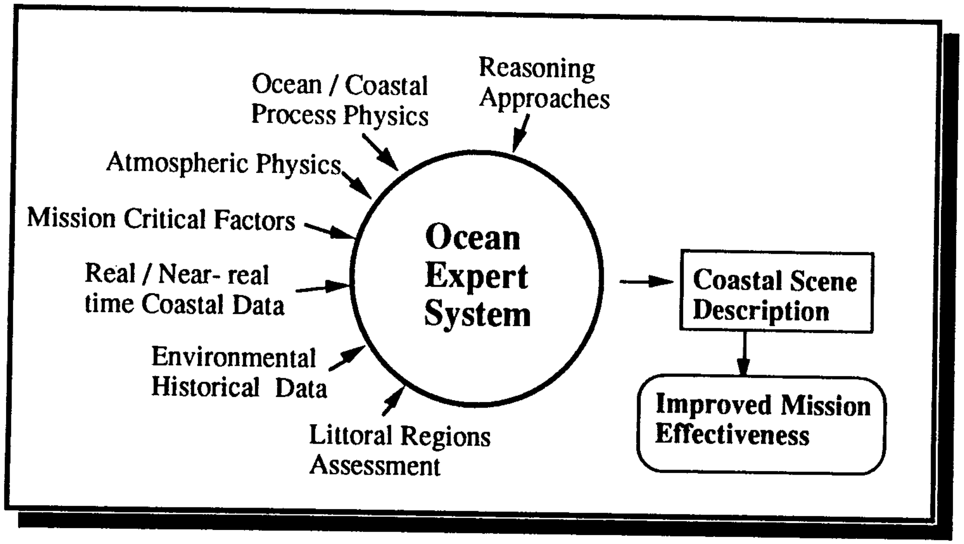
Topics

OES UPDATE:

- OES Project Objectives / Approach
- Amphibious Assault Scenario
- Important Coastal Processes: Upwelling; Fog; Sea Breeze; Surf ....
- Ocean Expert System Strawman Description
- Use of HyperText Markup Language (HTML)
- Narrative and Qualitative Description
- Upwelling / Fog: Sample World Regions

STATUS OF REGIONAL ATMOSPHERIC MODELING SYSTEM (RAMS) - C.E. Schemm and L.P. Manzi

Coastal Scene Description
Ocean Expert System



Objectives

- Provide mission dependent description of coastal environmental "scene" to enhance tactical decisions and mission effectiveness
- Provide the technology to support and implement the coastal scene description

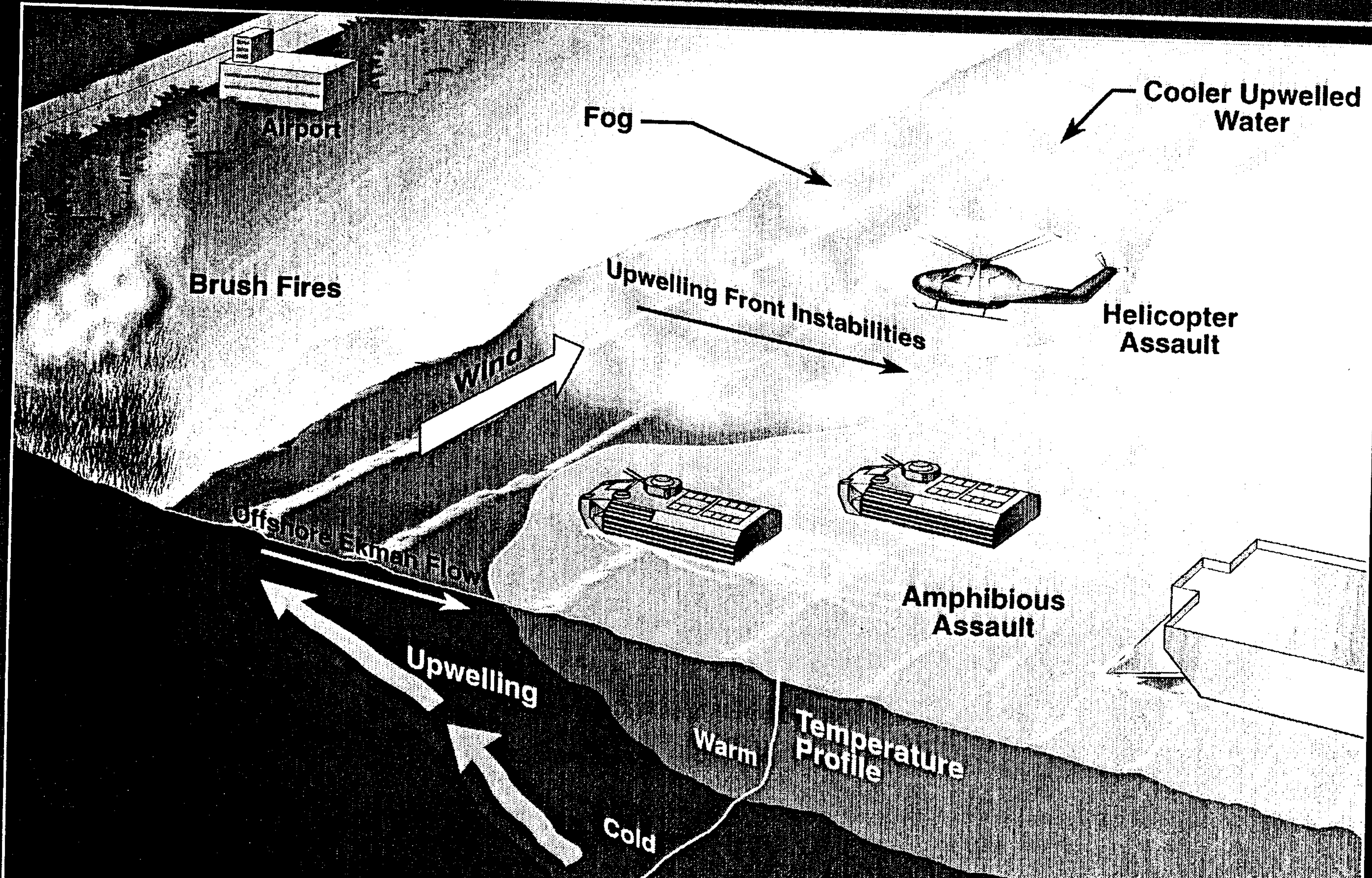
Approach

- Use mission to focus attention on coastal environmental critical factors
- Represent dominant oceanic and atmospheric processes which determine the critical environmental parameters
- Use expert system tools to unite process physics with real-time measurements and historical databases
- Focus on tactical decision maker who will use coastal scene description to enhance mission planning and execution

Deliverables

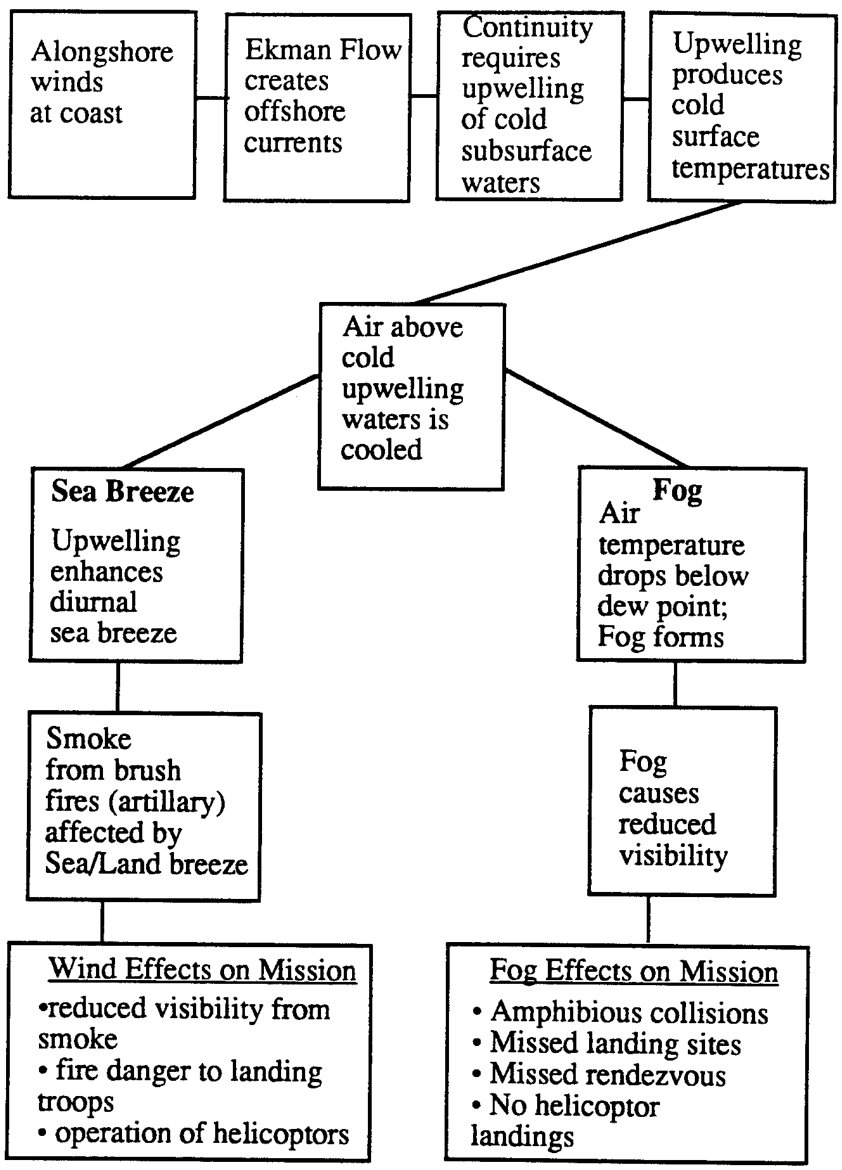
- Periodic computer-based demonstrations showing increasing functionality in individual components and integrated system
  - -FY94: Reasoning Tools, Envir. Data Bases, Display
  - -FY95: Amphibious Assault Process Physics (Upwelling, Fog)
  - -FY96: Mine Countermeasures
- Reports providing periodic assessments on importance of coastal processes in key foreign littoral regions
- Quarterly and Annual Status Reports, Technical Papers

Coastal Scene Description
Amphibious Assault
Upwelling/Fog



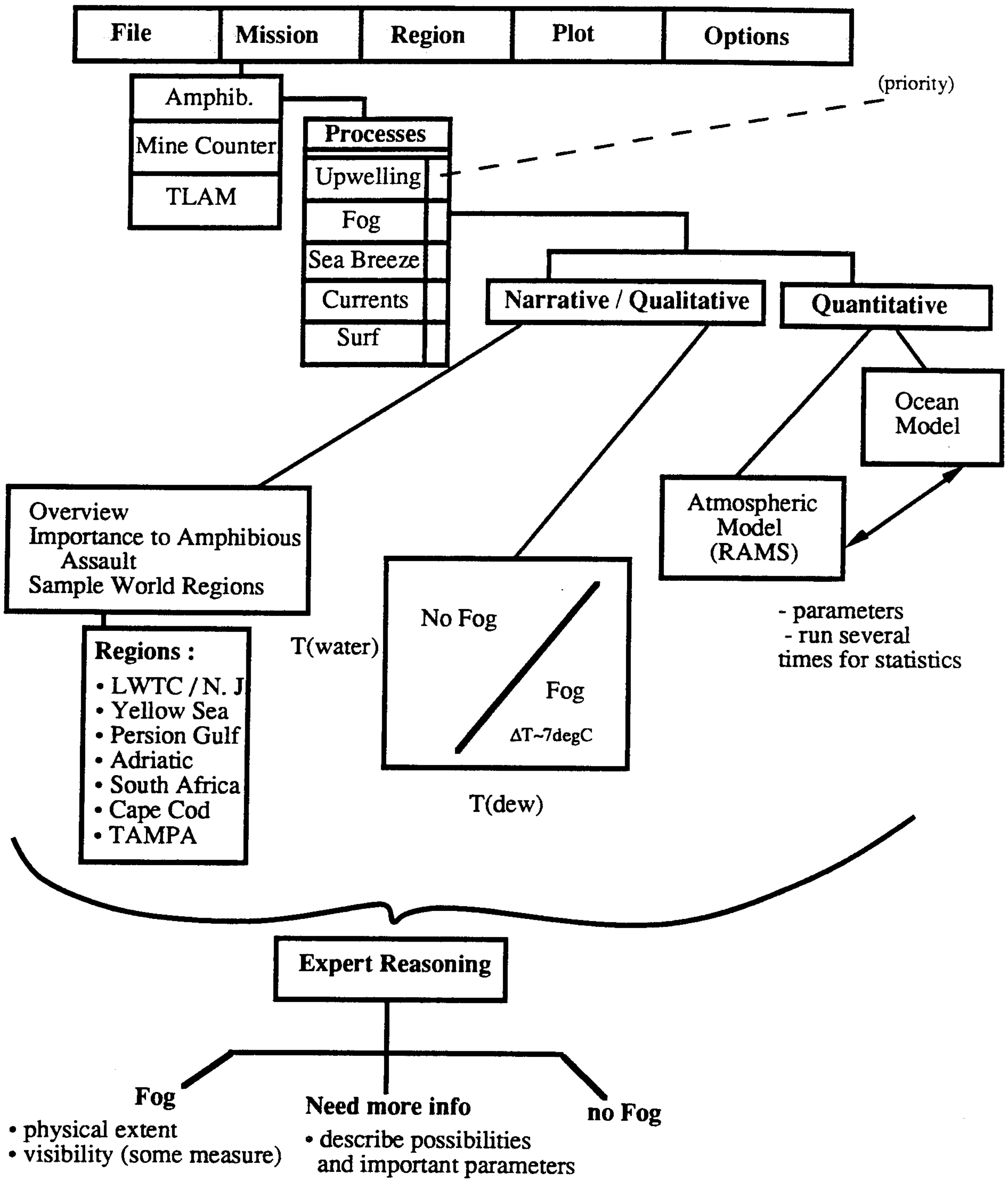
PS 2-95-11.04

Relationship of Atmospheric and Oceanographic Processes to Amphibious Assault Mission; Coastal Upwelling / Fog / Sea Breeze



Coastal Scene Description

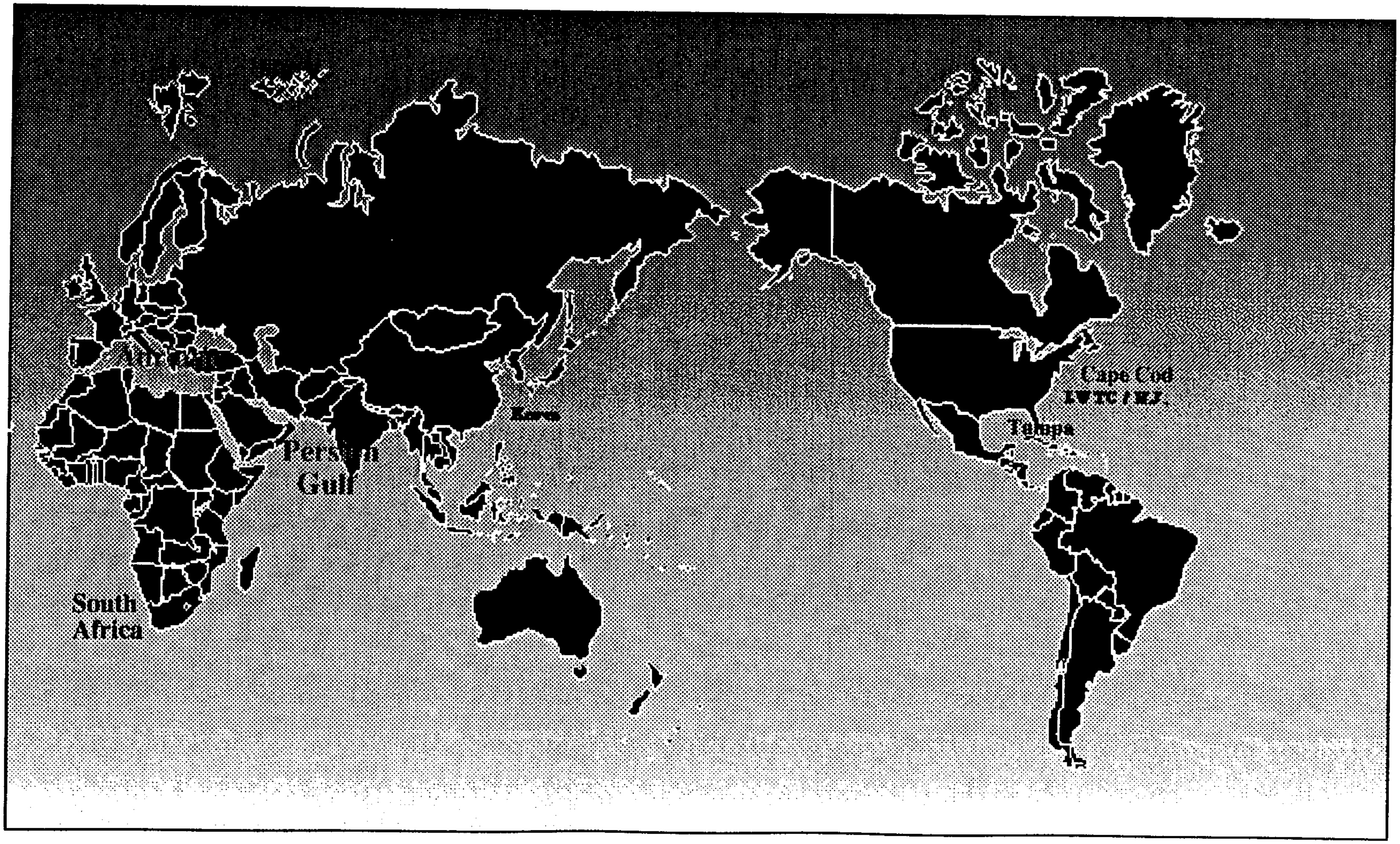
Ocean Expert System

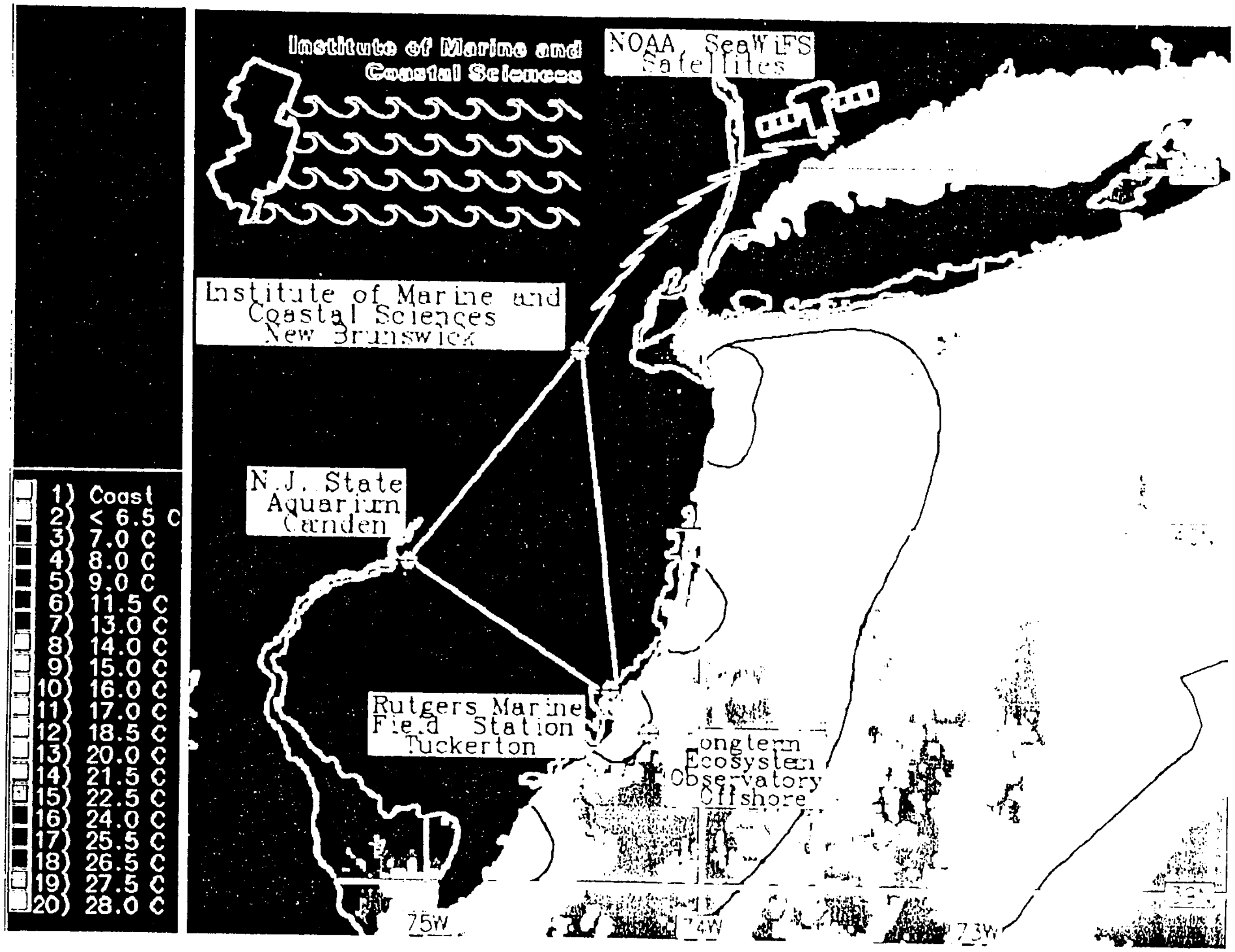


Coastal Scene Description

<u>Ocean Expert System</u>

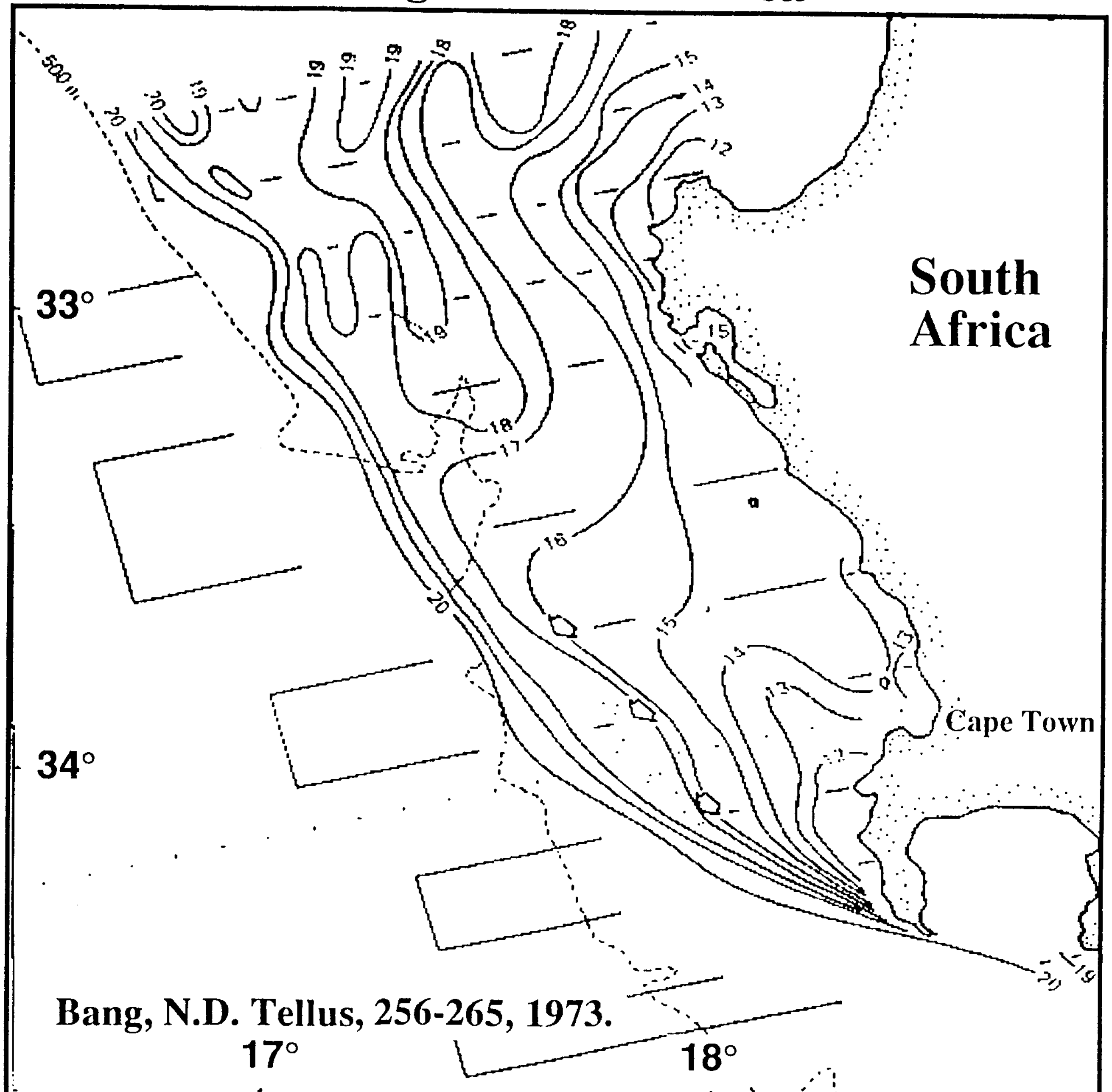
World Map Menu (Upwelling /Fog)





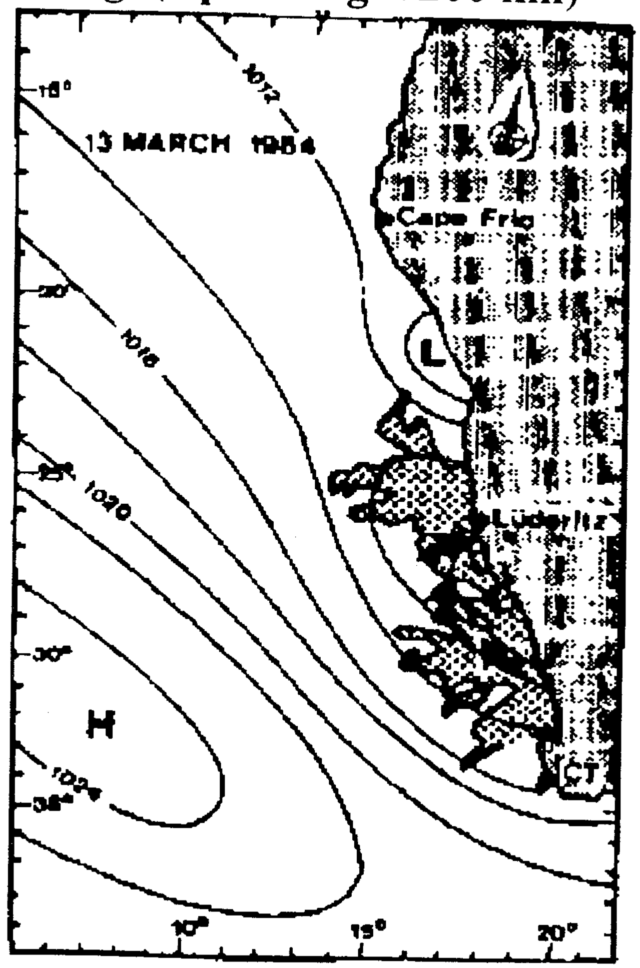
from :S.M. Glenn

Upwelling off South Africa

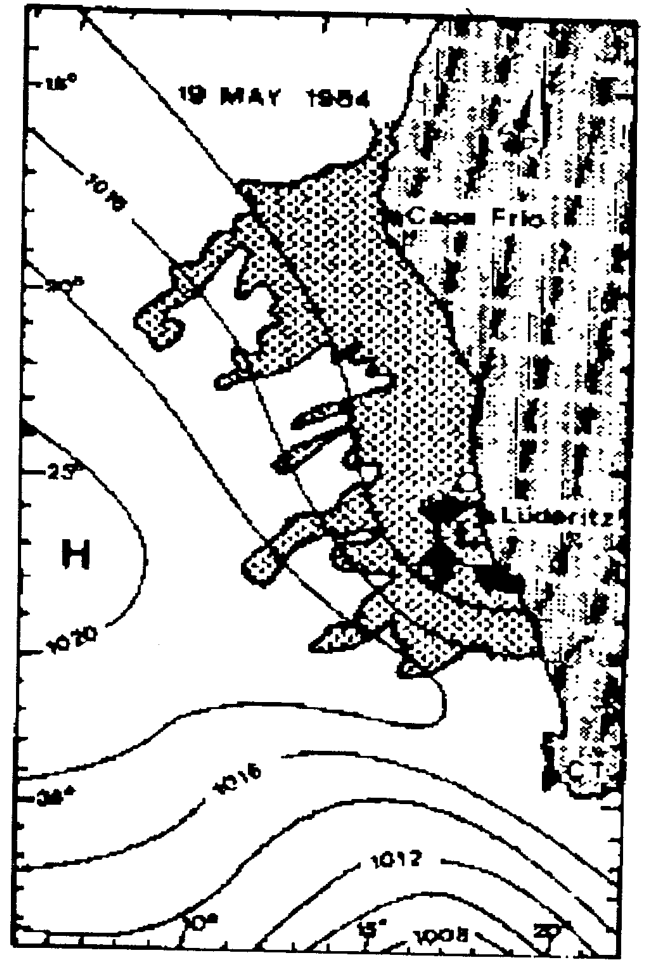


Upwelling & Fog (West Coast of S. Africa)

Fog (Upwelling < 200 km)

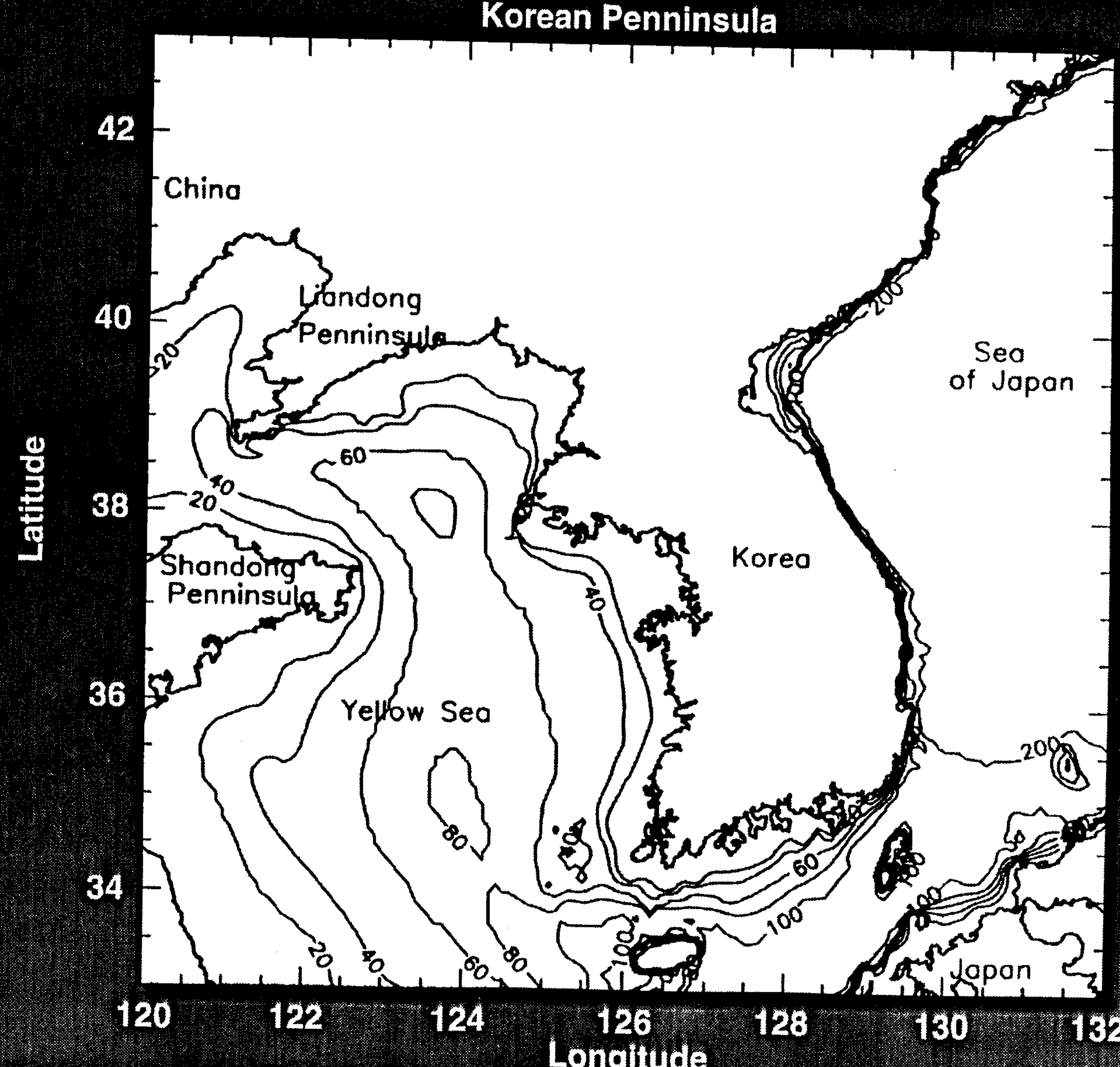


No Fog (Upwelling > 200km)



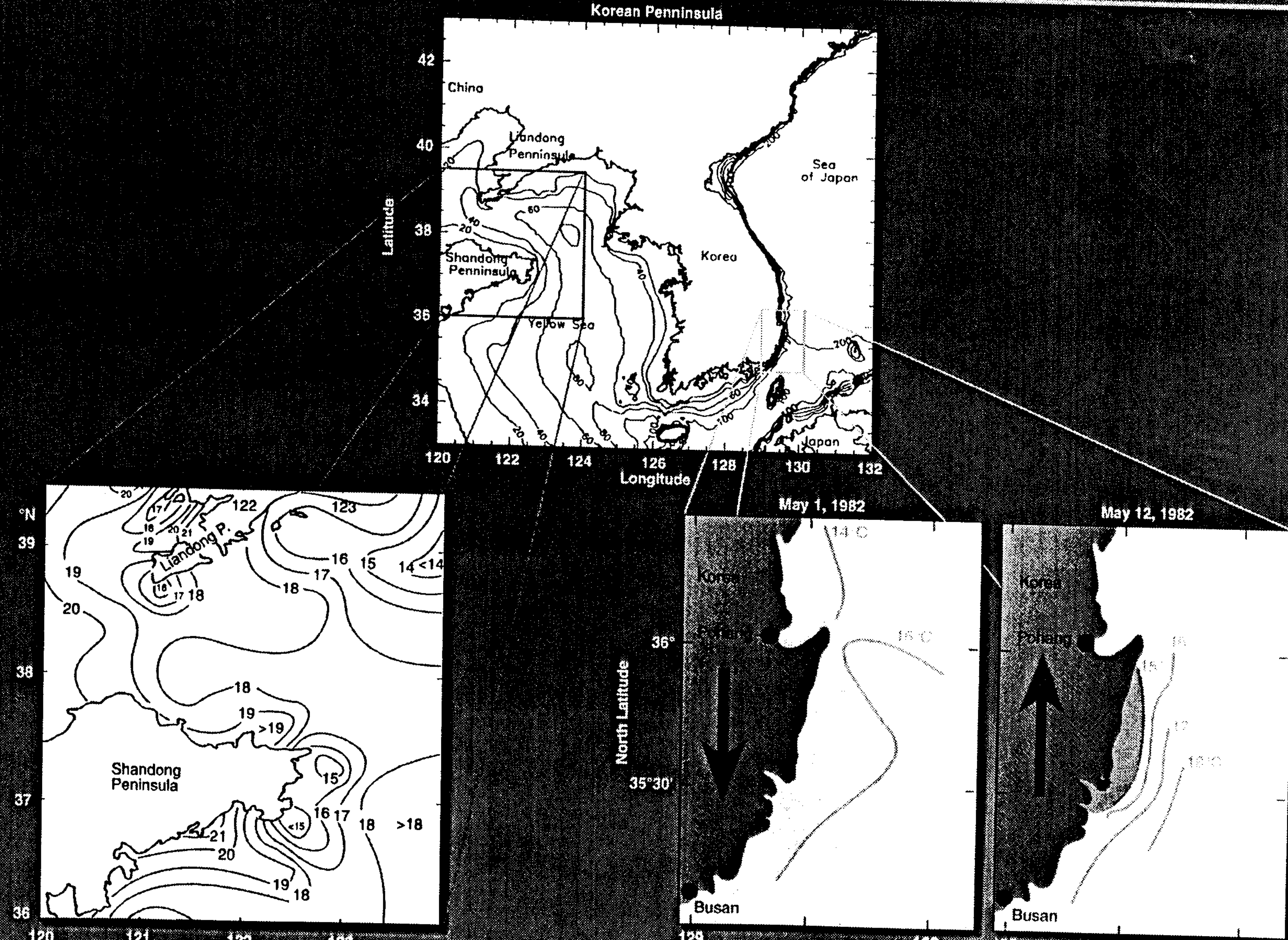
Oliver, J., and P.L. Stockton, "The Influence of Upwelling Extent Upon Fog Incidence at Luderitz, Southern Africa," International J. of Climatology, 9, 69-75.

Korea: Upwelling/Fog



PS 2-95-11.01

Korea: Upwelling/Fog

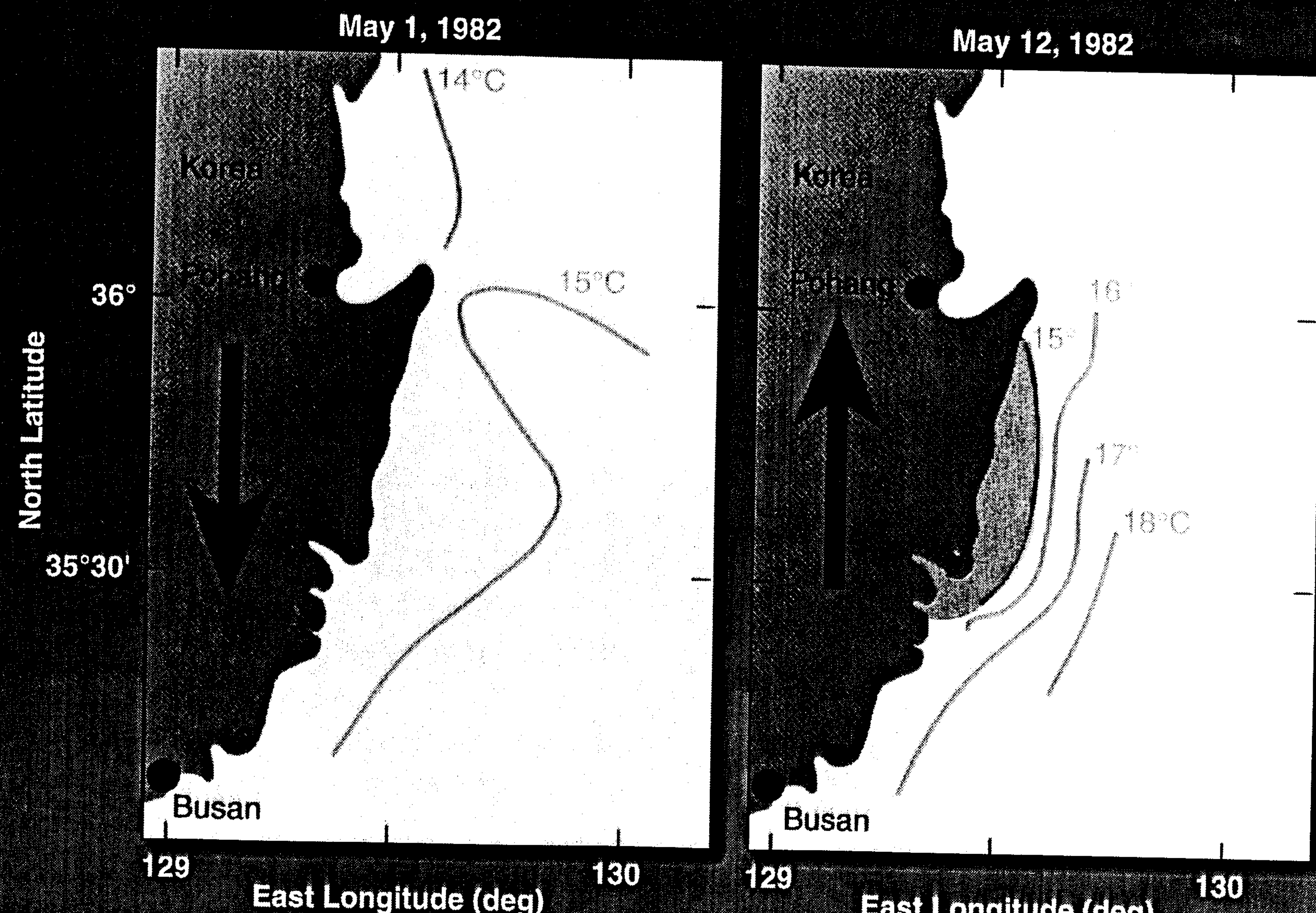


(From Guo and Zia, 1984, p. 124)

(Adapted from Byun and Seung, 1984)

PS 2-95-11.05

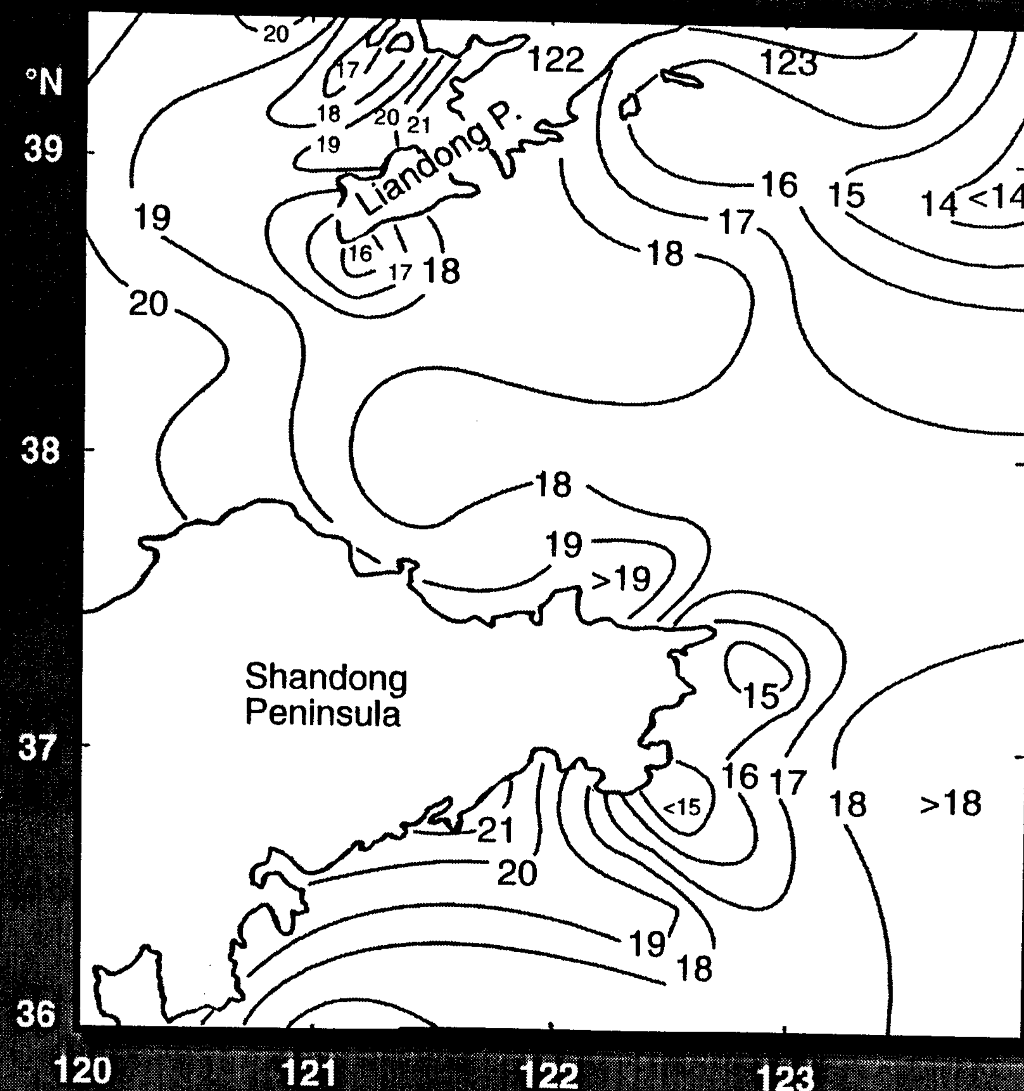
Upwelling Off South Korea



(Adapted from Byun and Seung, 1984)

PS 2-95-11.03

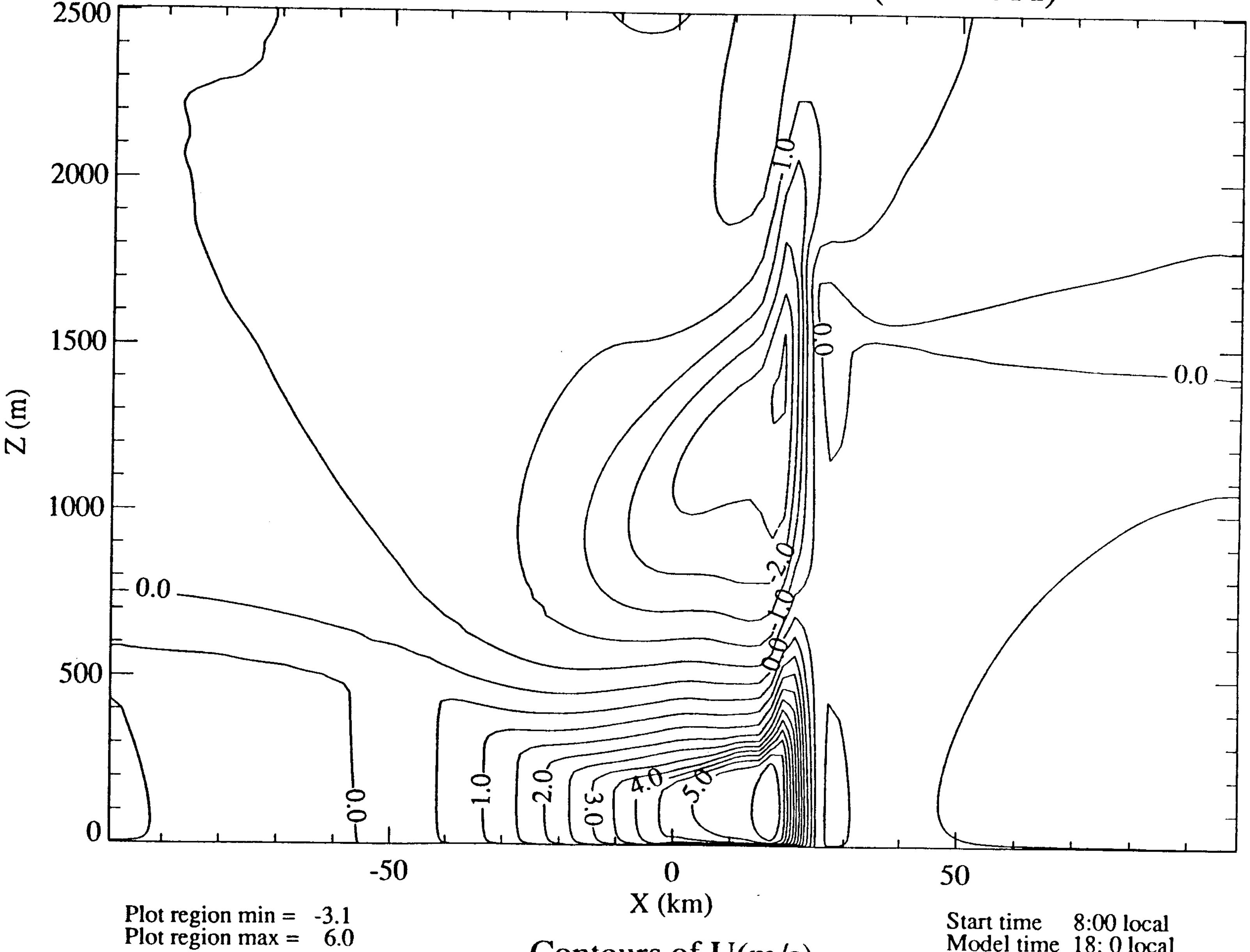
Upwelling in Yellow Sea



(From Guo and Zia, 1984, p. 124)

PS 2-95-11.02

RAMS Sea Breeze Predictions (TAMPA)



Contours of U(m/s)

Summary

- Work in progress for user friendly description of mission critical ocean and atmospheric environmental conditions for Amphibious Assault
- Scene description should include:
  - Narrative / Qualitative Description (Mission Relevant)
  - Quantitative Predictions from Ocean and Atmospheric Models
  - Expert Reasoning to handle scene description when detailed modeling not available due to lack of model or necessary input parameters
- OES scene description currently accesses sample embedded information / data on host computer but can access remote data via internet or Def. Sim. Internet
  - (e.g. Rutgers AVHRR images, or CTD data)
- HyperText Markup Language valuable for hardware independent display of local or remote data. Should be host computer independent.
- Will refine contents of OES and incorporate RAMS predictions.
- Install and integrate on SGI hardware at NRL/Stennis

THE REGIONAL ATMOSPHERIC MODELING SYSTEM (RAMS)

by

C. E. Schemm
L. P. Manzi

COASTAL SCENE DESCRIPTION MINI-WORKSHOP

Applied Physics Laboratory
University of Washington
Seattle, Washington

14 February 1995

OBJECTIVES

- Provide Capability to Predict Atmospheric Conditions Important to the Formation of Fog in the Marine Boundary Layer & Adjacent Coastal Areas

  » fully integrated in OES

  or

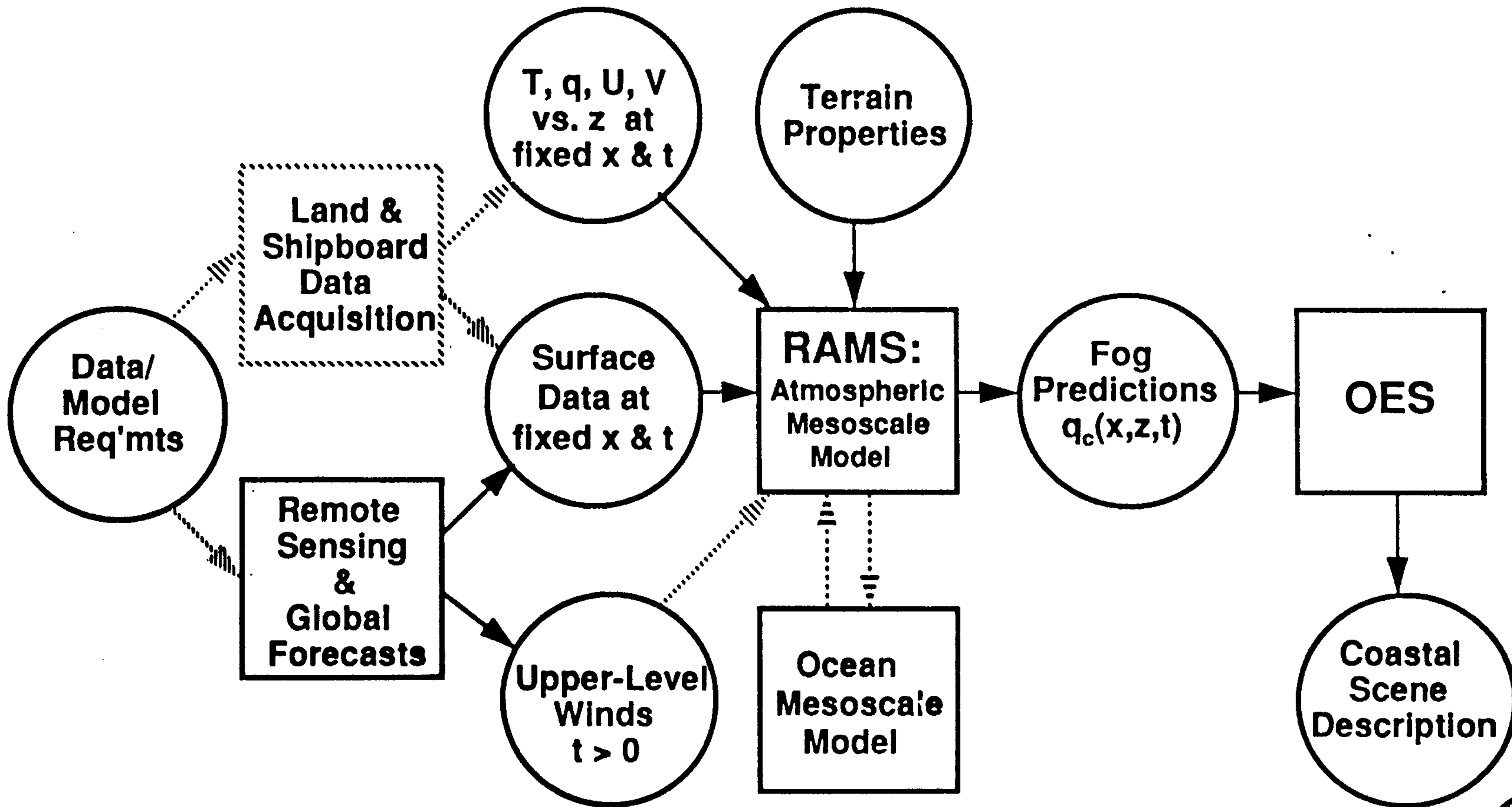
  » off-line with scenarios run to provide needed information

- Provide Capability to Predict Meteorological Variables (e.g., Surface Winds, Heat and Moisture Fluxes) Needed to Drive Regional Ocean Models

APPROACH

- USE COLORADO STATE UNIVERSITY REGIONAL ATMOSPHERIC MODELING SYSTEM (RAMS)
- CARRY OUT SERIES OF CHECKOUT/VALIDATION RUNS
  - 2- and 3-D versions of RAMS
  - investigate mesoscale phenomena of interest
    - » land/sea breeze cycle
    - » mountain/valley winds
    - » cloud & fog formation
  - compare with data & with analytical model solutions
  - test sensitivity to gridpoint resolution, initialization, boundary conditions, etc.
- FOCUS ON INITIAL DEMONSTRATION
  - Mid-Atlantic Bight

Possible Operational Model Scenario



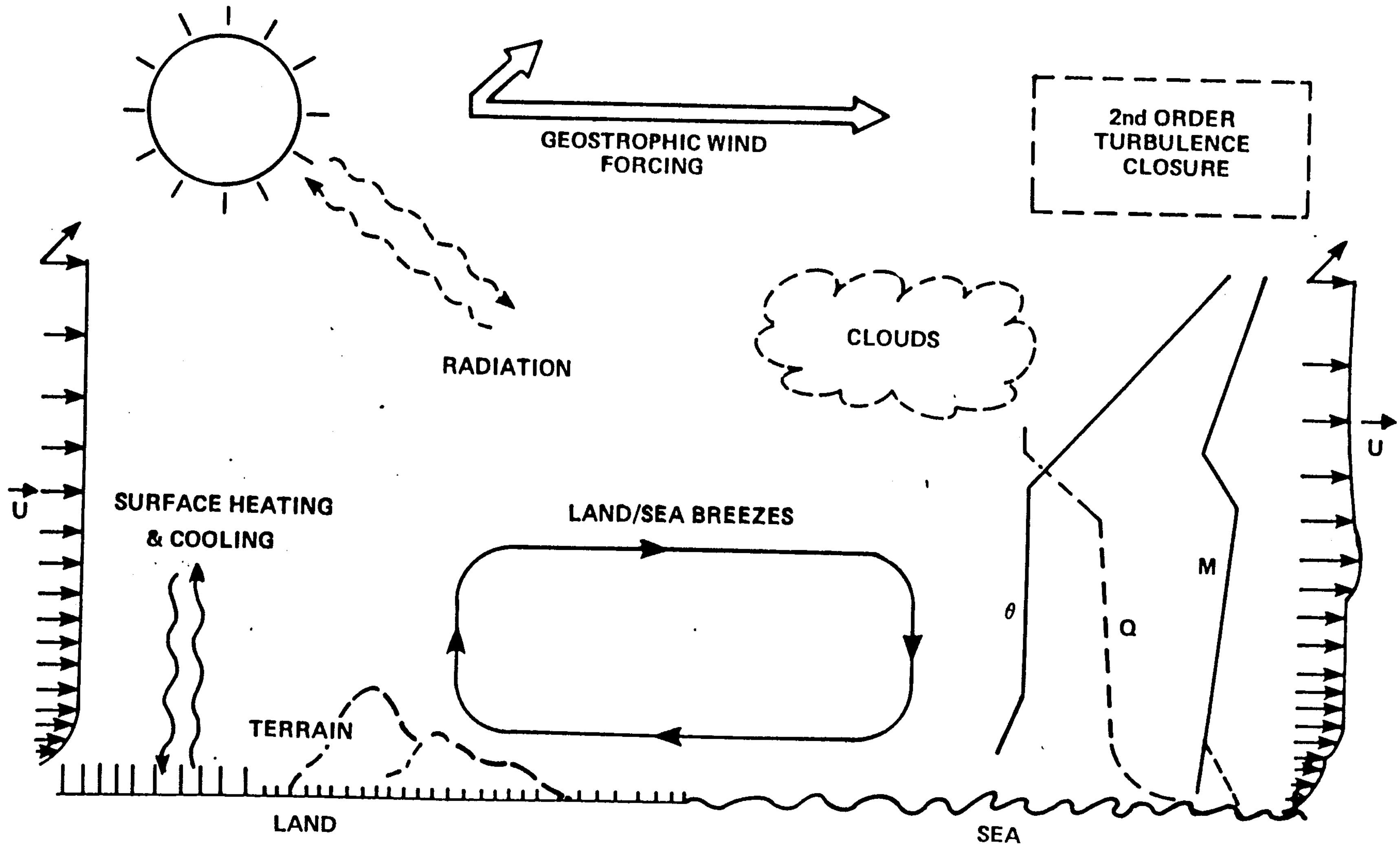
OUTLINE

- DESCRIPTION OF RAMS
- SAMPLE CALCULATIONS
  - Sea Breeze, Flat Terrain (Tampa, FL)
  - Mountain/Valley Winds (Bell-Shaped Mountain)
  - Cloud Generation
- PLANNED FUTURE ACTIVITIES

THE COLORADO STATE UNIVERSITY REGIONAL ATMOSPHERIC MODELING SYSTEM

- Offspring of Two R&D Models in Existence since the 1970s
  - CSU Mesoscale Model (R. Pielke)
  - CSU Cumulus Model (W. Cotton)
- Maintained by and Licensed through ASTeR, Inc.
  - division of Mission Research Corp.
  - C. Tremback, R. Walko
- Acquired by JHU/APL in 1994 for Application to Radar Propagation Studies
  - replacement for an in-house code developed in 1980s
- Features not Generally Available in Mesoscale Models
  - sigma-z coordinates with variable vertical resolution
  - nested grid in horizontal allows high resolution locally
  - non-hydrostatic option
  - cloud microphysics (4 levels of complexity)
  - option to initialize from NMC global analyses

2–D MESOSCALE MODEL



APL PLANETARY BOUNDARY LAYER MODEL

PHYSICS

- 3D Reynolds Averaged Eqns. - Boussinesq and Hydrostatic Appxs.
- Differential Equations for U, V, Θ and Q (Specific Humidity)
  - vertical velocity and pressure obtained algebraically
- 2D + Time Version Neglects Cross-Track Derivatives
- Assumption of Horizontal Homogeneity $\Rightarrow$ 1D + Time Version

$$\frac{\partial U}{\partial t} = +f(V - V_g) - \frac{\partial}{\partial z} < u'w' > \qquad \frac{\partial V}{\partial t} = -f(U - U_g) - \frac{\partial}{\partial z} < v'w' >$$

$$\frac{\partial \theta_v}{\partial t} = -\frac{\partial}{\partial z} < w'\theta_v' > + S_\theta \qquad \frac{\partial Q}{\partial t} = -\frac{\partial}{\partial z} < w'q' >$$

- Eddy Viscosity or 2nd-Order Turbulence Closure Schemes

NUMERICS

- Staggered Grid with Logarithmically Stretched Vertical Coordinate
  - $\Delta z \approx 10$ to 50 m
- Leapfrog Time Differencing
  - diffusive terms treated implicitly (75% weighting to forward time step)

Table 1. *Model Characteristics and Options*

Category	Available options	References and additional remarks
Basic equations	• Nonhydrostatic; compressible	Tripoli and Cotton (1980).
	• Hydrostatic; anelastic or incompressible	Tremback et al. (1985).
Dimensionality	• 1D	
	• 2D	
	• 3D	
Vertical coordinates	• Cartesian	
	• Terrain-following σ_z	Clark (1977); Tripoli and Cotton (1982).
Horizontal coordinates	• Cartesian	
	• Stereographic tangent plane	Projection tangent point can be located anywhere on sphere.
Grid stagger and structure	• Arakawa C grid, single grid (fixed)	
	• Arakawa C grid, multiple nested grids (fixed)	No limit on number of grids; no limit on number of nesting levels; grids can be added/removed during simulation.
	• Arakawa C grid, multiple nested grids (movable)	
Time differencing	• Leapfrog; time split; 2nd or 4th order spatial accuracy	Leapfrog on long timestep, forward-backward on small timestep; flux conservative form (Tripoli and Cotton, 1982).
	• Forward; 2nd or 6th order spatial accuracy	Forward-backward time-split; flux conservative form (Tremback et al., 1987).
Turbulence closure	• Smagorinsky deformation K	*Ri* dependence (Tripoli, 1986).
	• O'Brien K/Blackadar K	O'Brien first-order K for unstable conditions; Blackadar Local K for stable conditions (McNider and Pielke, 1981).
	• Deardorff level 2.5 K	Eddy viscosity is a function of prognostic TKE (Deardorff, 1980).
Stable precipitation	• No condensation	
	• Condensation	Grid points fully saturated or unsaturated.
Cumulus parameterization	• None	
	• Modified Kuo	Tremback (1990).
Explicit microphysics	• None	
	• Warm microphysics	Warm rain conversion and accretion of cloud water (r_c) to raindrops (r_r); evaporation and sedimentation (Tripoli and Cotton, 1980).
	• Ice microphysics – specified nucleation	Warm microphysics plus nucleation of ice crystals (r_i), conversion nucleation and accretion of graupel (r_g), growth of ice crystals (r_i), evaporation, melting and sedimentation (Cotton et al., 1982).
	• Ice microphysics – predicted nucleation	Warm microphysics plus above plus nucleation and sink of crystal concentration (N_i), conversion and growth of aggregates (r_a), melting, evaporation and sedimentation. The nucleation model includes: sorption/deposition; contact nucleation by Brownian collision plus thermophoresis plus diffusiophoresis; and secondary ice crystal production by rime-splinter mechanism (Cotton et al., 1986; Meyers et al., 1991).
Radiation	• No radiation	
	• Shortwave I	Molecular scattering, absorption of clear air (Yamamoto, 1962), ozone absorption (Lacis and Hansen, 1974) and reflectance, transmittance and absorptance of a cloud layer (Stephens, 1978), clear-cloudy mixed

Table 1. (*Continued*)

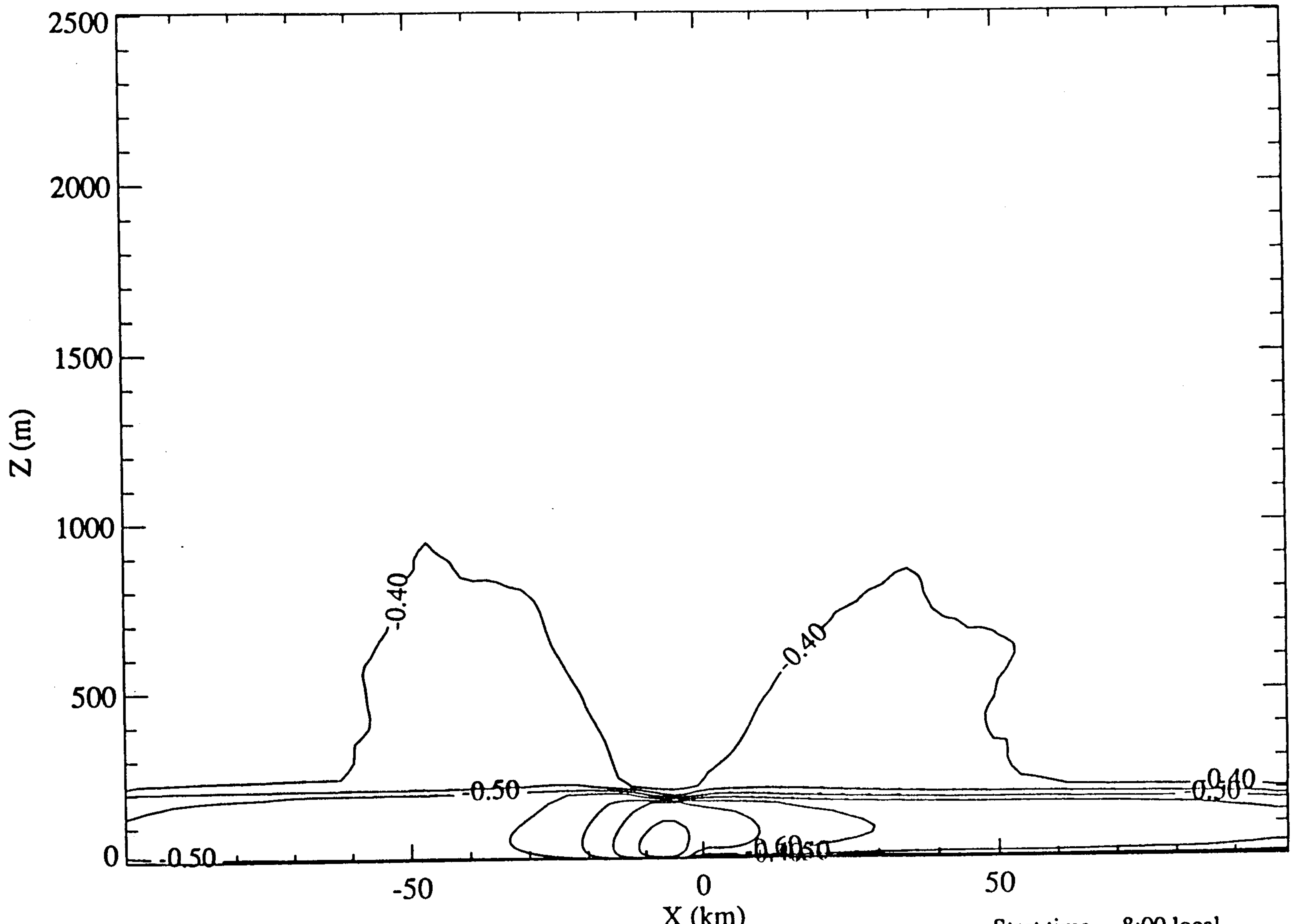
Category	Available options	References and additional remarks
		layer approach (Stephens, 1977). See Chen and Cotton (1983, 1987).
	• Shortwave II	Effects of forward Rayleigh scattering (Atwater and Brown, 1974), absorption by water vapor (McDonald, 1960), and terrain slope (Kondrat'yev, 1969). See Mahrer and Pielke (1977).
	• Longwave I	Emissivity of a clear atmosphere (Rodgers, 1967), emissivity of cloud layer (Stephens, 1978), and emissivity of "clear and cloudy" mixed layer (Herman and Goody, 1976). See Chen and Cotton (1983, 1987).
	• Longwave II	Emissivities of water vapor (Jacobs et al., 1974) and carbon dioxide (Kondrat'yev, 1969) and the computationally efficient technique of Sasamori (1972). See Mahrer and Pielke (1977).
Surface layer	• Louis (1979)	Surface roughness specified over land, predicted over water.
Lower boundary	• Specified air-surface temperature and moisture differences	
	• Diagnosed surface temperature and moisture fluxes based on a prognostic soil model	Tremback and Kessler (1985); McCumber and Pielke (1981).
	• Vegetation parameterization	McCumber and Pielke (1981); Avissar and Mahrer (1988); Lee (1992).
Upper boundary	• Rigid lid	Nonhydrostatic model only.
	• Prognostic surface pressure	Hydrostatic model only.
	• Material surface	Hydrostatic model only (Mahrer and Pielke, 1977).
	• Gravity-wave radiation condition	Klemp and Durran (1983).
	• Optional Rayleigh friction layer	With any of the above conditions (Clark, 1977; Cram, 1990).
Lateral boundaries	• Radiative boundary condition I	Orlanski (1976).
	• Radiative boundary condition II	Klemp and Wilhelmson (1978a, b).
	• Radiative boundary condition III	Klemp and Lilly (1978).
	• Radiative boundary condition and MCR	Fixed conditions at Mesoscale Compensation Region (MCR) boundary (Tripoli and Cotton, 1982).
	• Large-scale sponge boundary conditions	Synoptic-scale boundary forcing (Perkey and Kreitzberg, 1976).
	• Large-scale nudging boundary conditions	Synoptic-scale boundary forcing (Davies, 1983).
Initialization	• Horizontally homogeneous (HHI)	
	• HHI plus variations to force cloud initiation	
	• Variable initialization I	NMC and ECMWF data interpolated directly to model grid.
	• Variable initialization II	Isentropic analysis of NMC or ECMWF data and/or upper air soundings and interpolated to model grid (Tremback, 1990).
Transport and diffusion	• Lagrangian particle dispersion module	Handles point, line, area or volume sources (McNider, 1981; McNider et al., 1988; Uliasz, 1993).

SEA-BREEZE CALCULATION: TAMPA, FL

- 2-D Version of RAMS
  - oriented perpendicular to coastline
  - 200 km horizontal domain with $\Delta x = 2$ km
  - 4 km vertical extent; stretched grid with max $\Delta z = 26$ m
- Options
  - non-hydrostatic
  - flat terrain
  - no clouds
- Initialization
  - single rawinsonde at 0800LT, 13 July 1993
- Surface Forcing
  - sea-surface temperature fixed at 29 degC (climatology)
  - heat & moisture fluxes over land calculated
- Model Run for 12 Hours
- Predicted Observed Reversal in Surface Winds

The Johns Hopkins University
APPLIED PHYSICS LABORATORY

RAMS Sea Breeze Predictions (Tampa)



Plot region min = -0.7
Plot region max = -0.3

Contours of U(m/s)

Start time 8:00 local
Model time 10: 0 local

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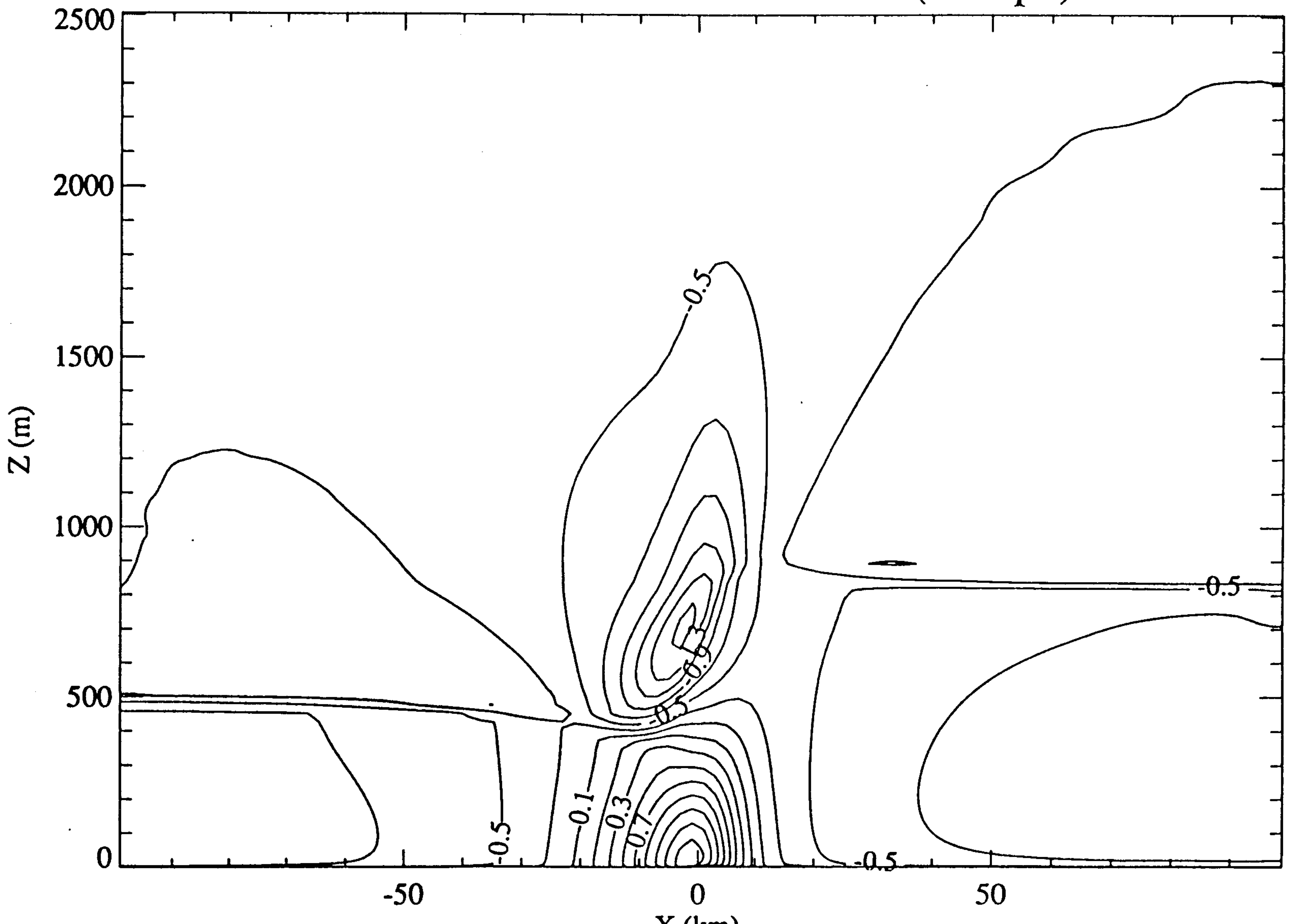
APPLIED PHYSICS LABORATORY

RAMS Sea Breeze Predictions (Tampa)



Plot region min = -1.6
Plot region max = 1.7

Contours of U(m/s)

Start time 8:00 local
Model time 14: 0 local

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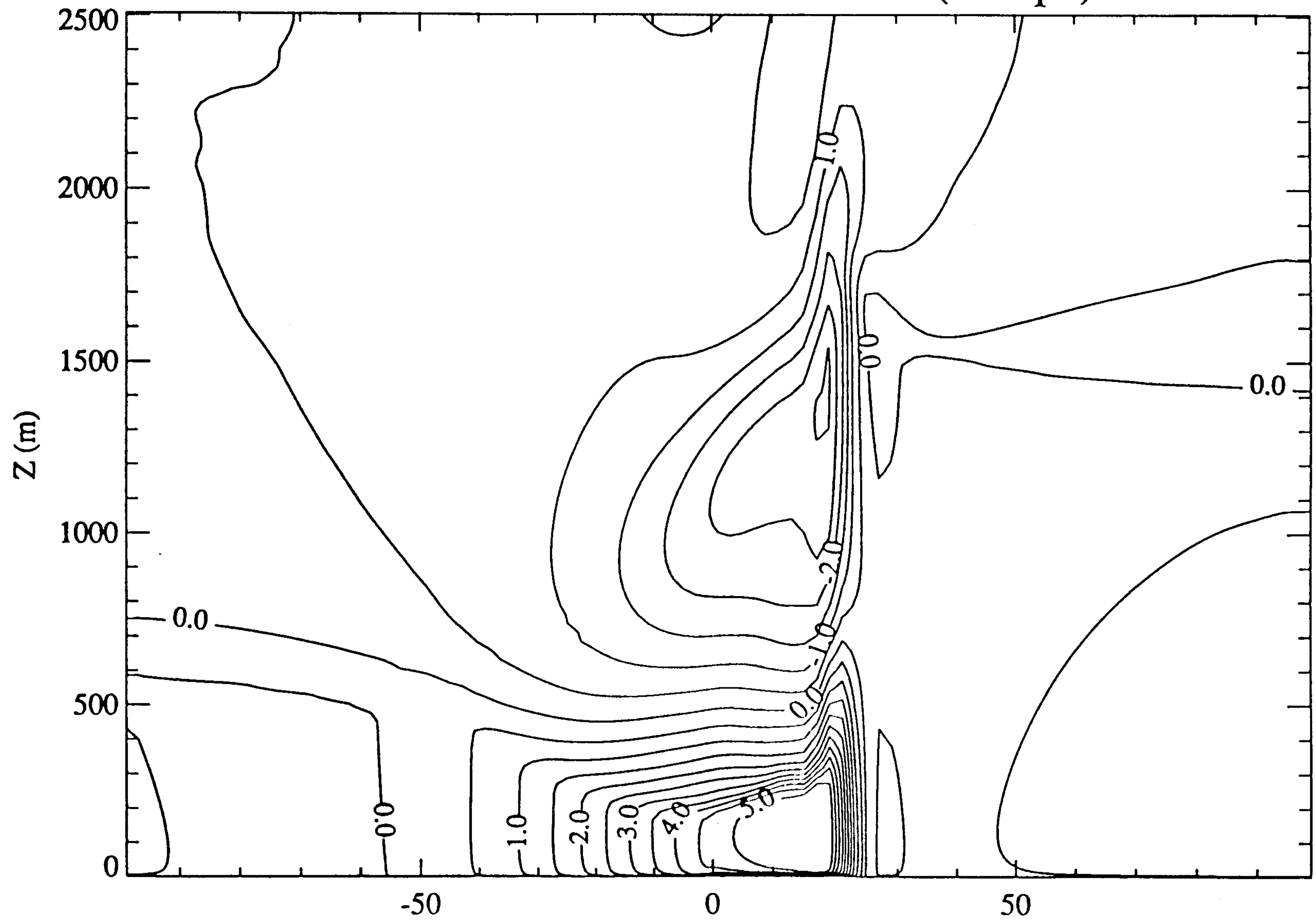
RAMS Sea Breeze Predictions (Tampa)



Plot region min = -3.1
Plot region max = 6.0

Contours of U(m/s)

Start time 8:00 local
Model time 18: 0 local

VARIABLE-TERRAIN CALCULATION

- Flow over Idealized Mountain
  - bell-shaped with $z_s(x) = ha^2/(x^2 + a^2)$
  - $h = 10$ m; $a = 10$ km
- Analytical Solution for Small Perturbations
  - Durran & Klemp, MWR, 1983
- RAMS Model Parameters
  - 180 x 16 km with $\Delta x = 2$ km & $\Delta z = 200$ m
  - 8 km absorbing layer at top
- Initial Conditions
  - isothermal: $T = 250K$
  - no moisture
  - $U = 20$ m/sec (uniform)
- Model Integrated to Steady State

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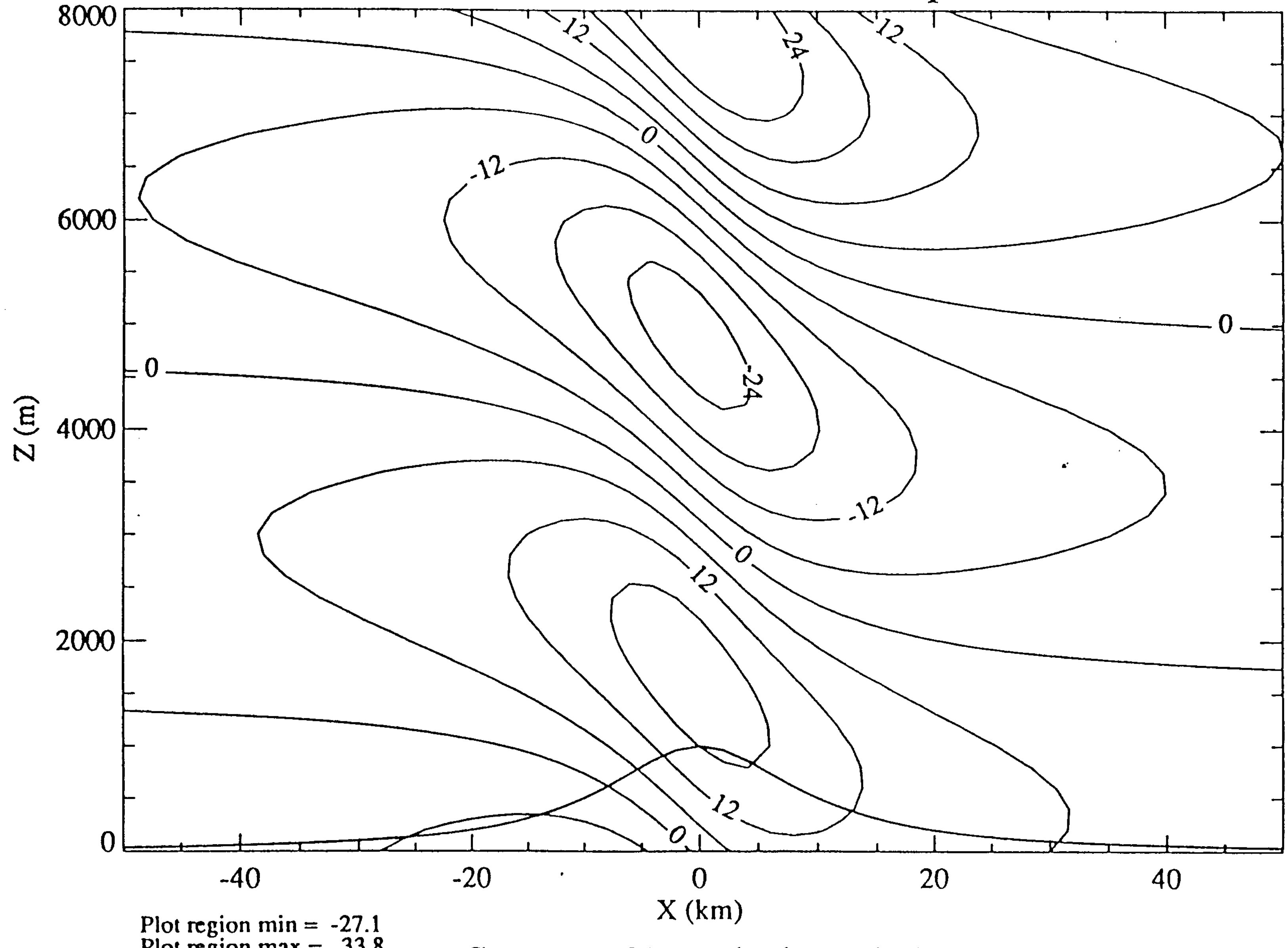
Analytic Solution: Flow over Bell-shaped Mountain



Contours of Perturbation U(m/s)

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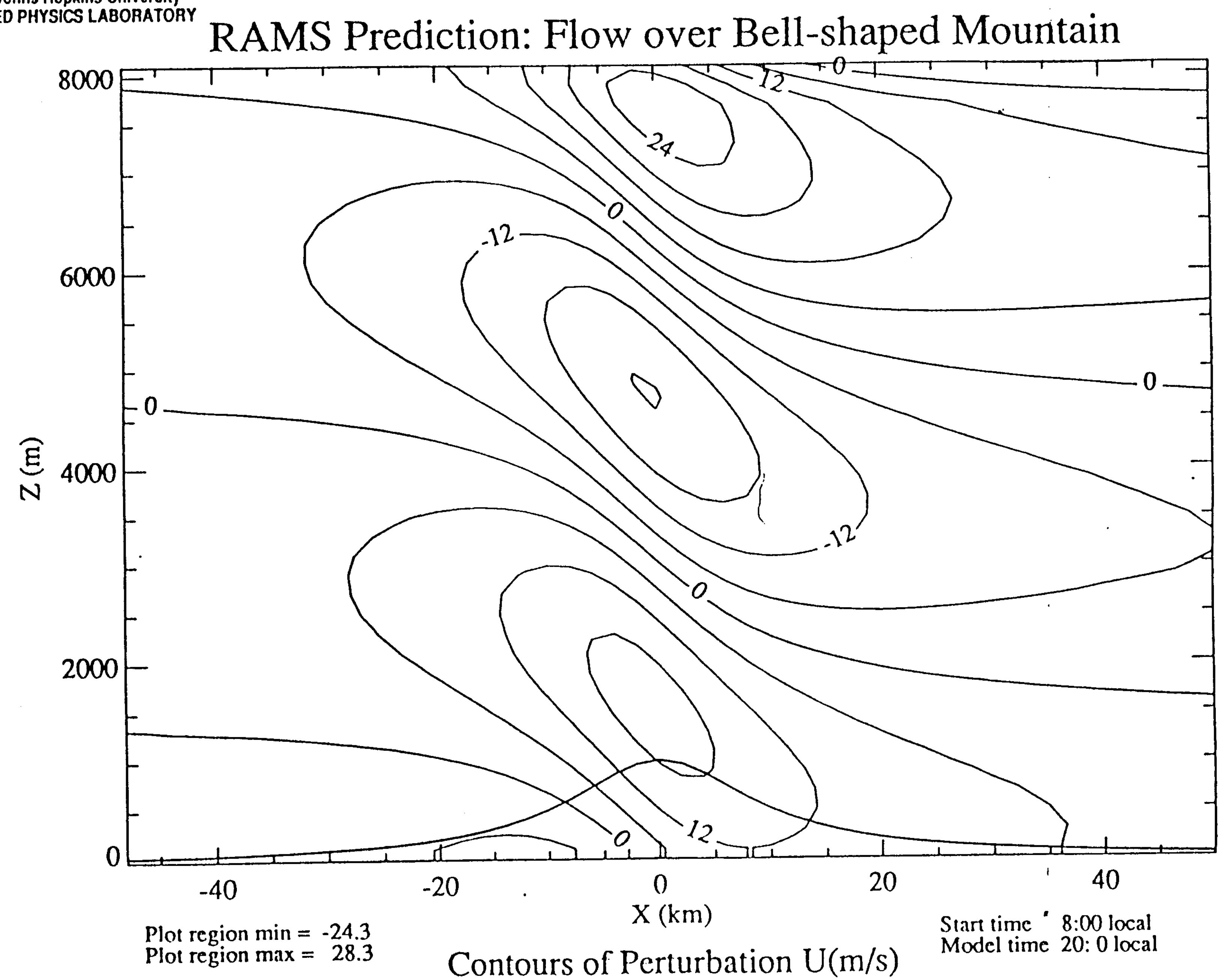

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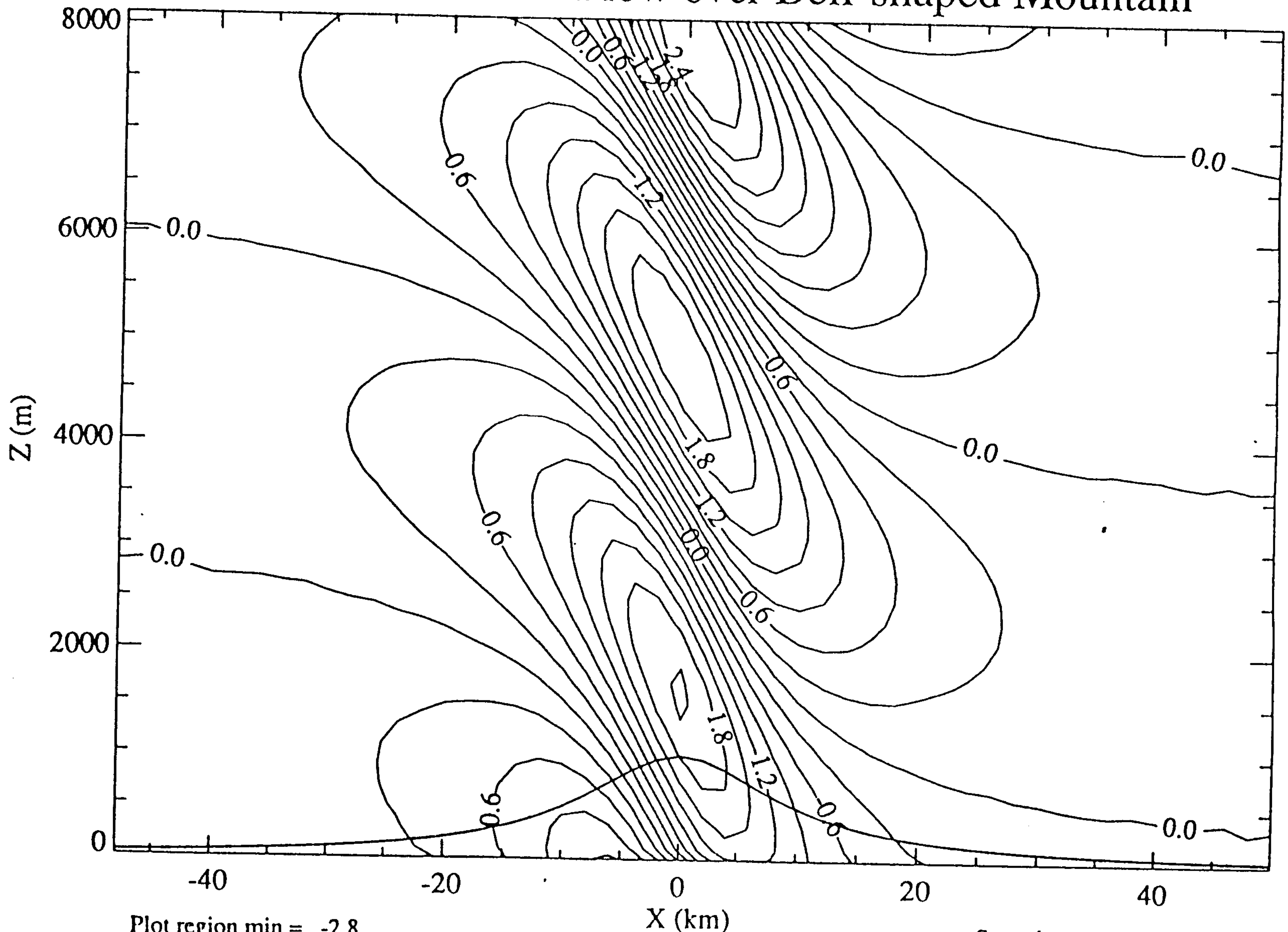
RAMS Prediction: Flow over Bell-shaped Mountain



Contours of Perturbation W(m/s)

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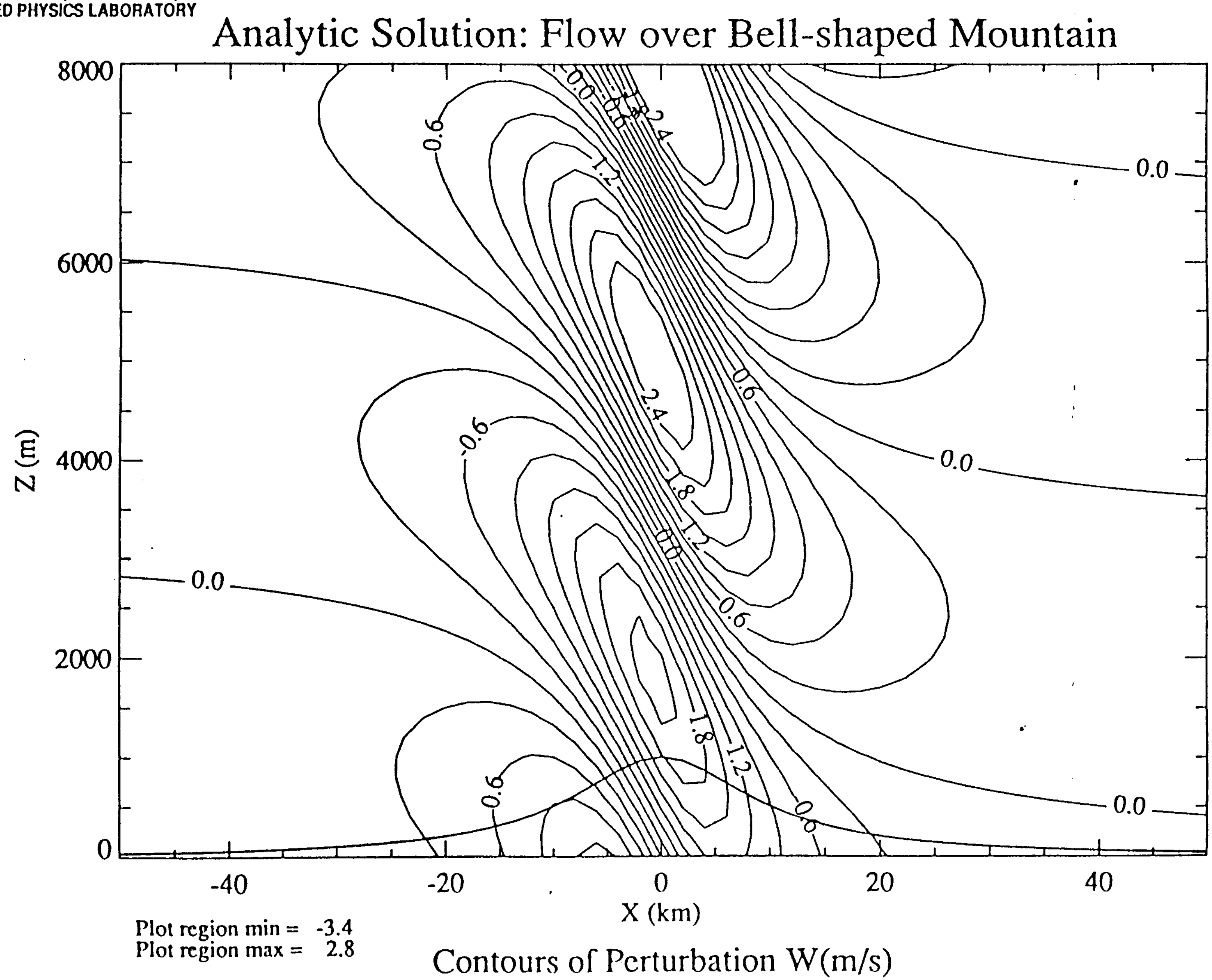

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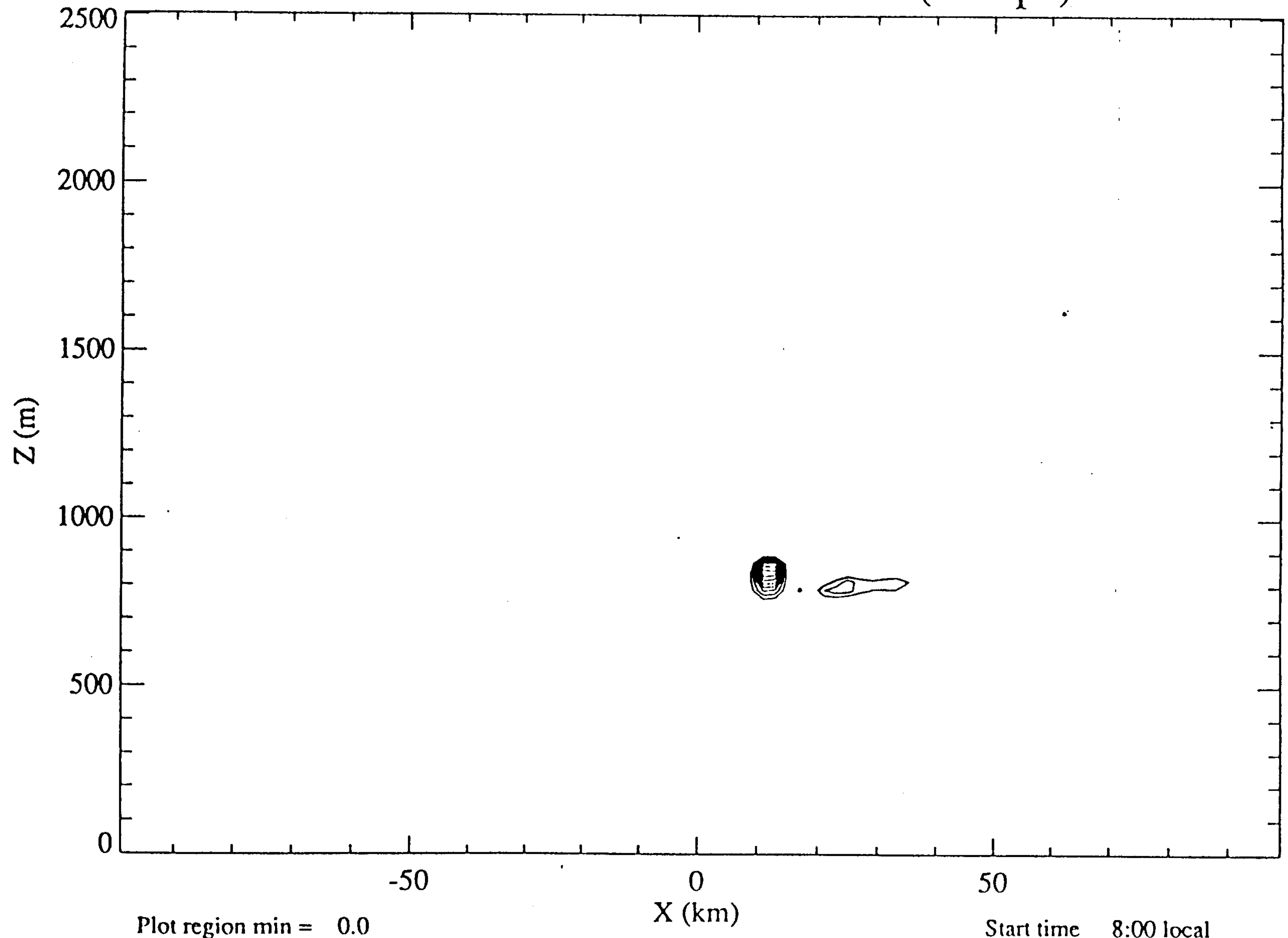
RAMS Sea Breeze Predictions (Tampa)



Contours of Cloud Water (g/kg)

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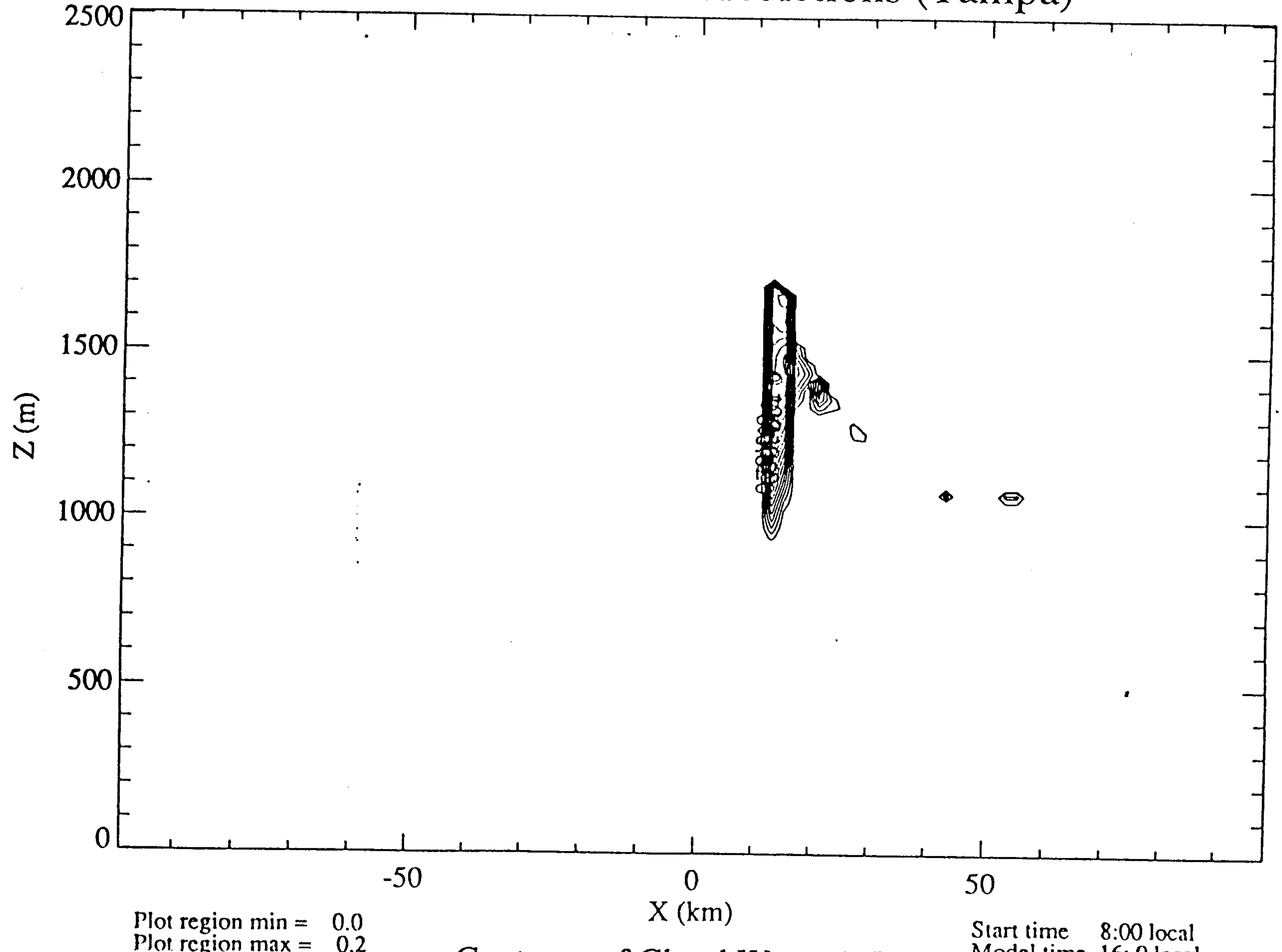
RAMS Sea Breeze Predictions (Tampa)

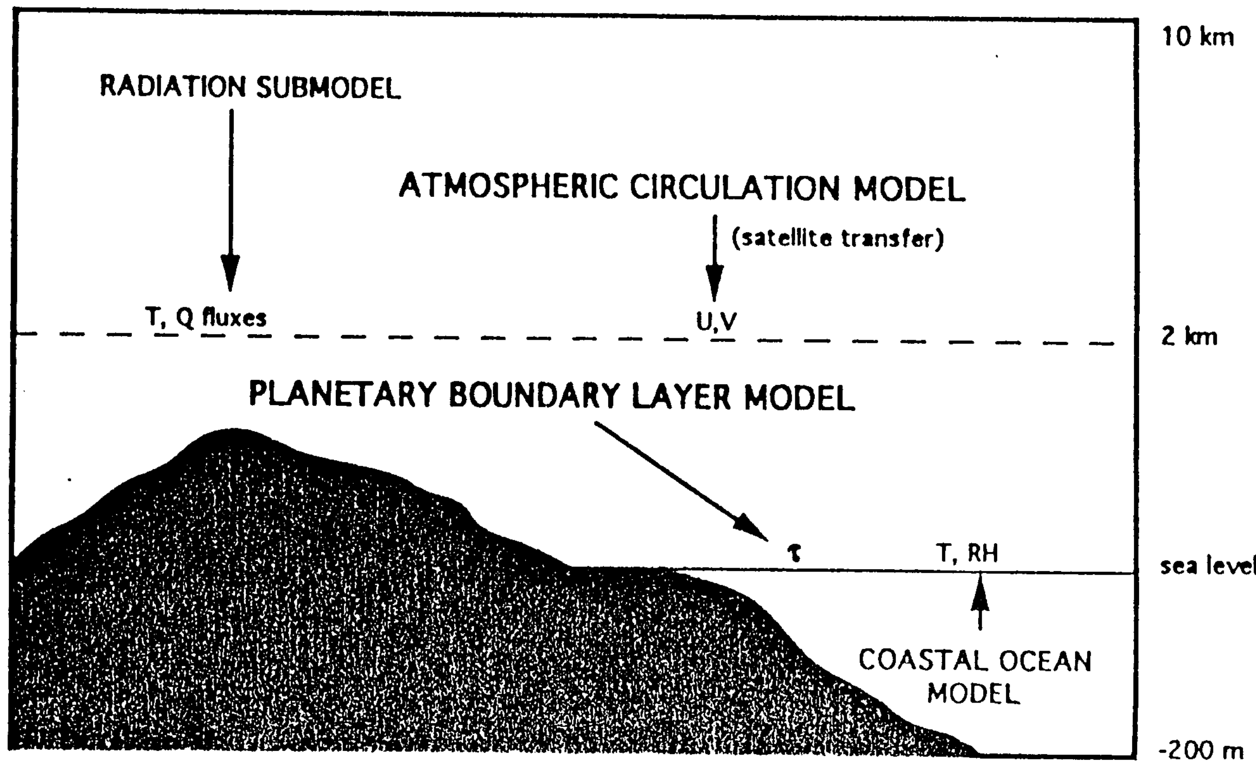


Contours of Cloud Water (g/kg)

SUMMARY

- Preliminary Model Testing Underway
- Results to Date Encouraging
- Issues Remaining to be Addressed
  - Ability to predict fog
    - » need for cloud microphysics
  - Required model configuration
    - » spatial resolution
    - » adequacy of 2-D predictions
  - Availability of data for demonstration
    - » initialization: vertical profile(s) of U, V, T & RH
    - » boundary conditions (time-dependent):
      - surface temperature
      - upper-level winds

REQUIRED MODEL INTERFACES



Goals of this meeting

Assess shared goal
Identify what we have
Identify what we need: software/hardware
Assess how to get what we need

A. What are the demands of the mission?

B. What do we mean by integration?

1. Software packages - which ones integrate?
2. Identify integration difficulty

C. What is our agreed upon definition of the ultimate goal for the Coastal Scene Description?

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What is our utlimate shared goal?

A. Provide Enviromental Coastal Scene Descriptions that are shareable (over the network) by real and simulated entities

1. Historical data - database
2. Real instruments
3. Virtual instruments

B. Underlying Network Architecture

DIS (?)

Action Items

A. Little Creek, Norfolk, Navy's amphibious warfare

B. Terrain Data

ACOM (Atlantic Command), Quantico, VA

Major Mosely

C. Oceanographic Data

Oceanographer of Navy, MC&G

CAPT Huncada

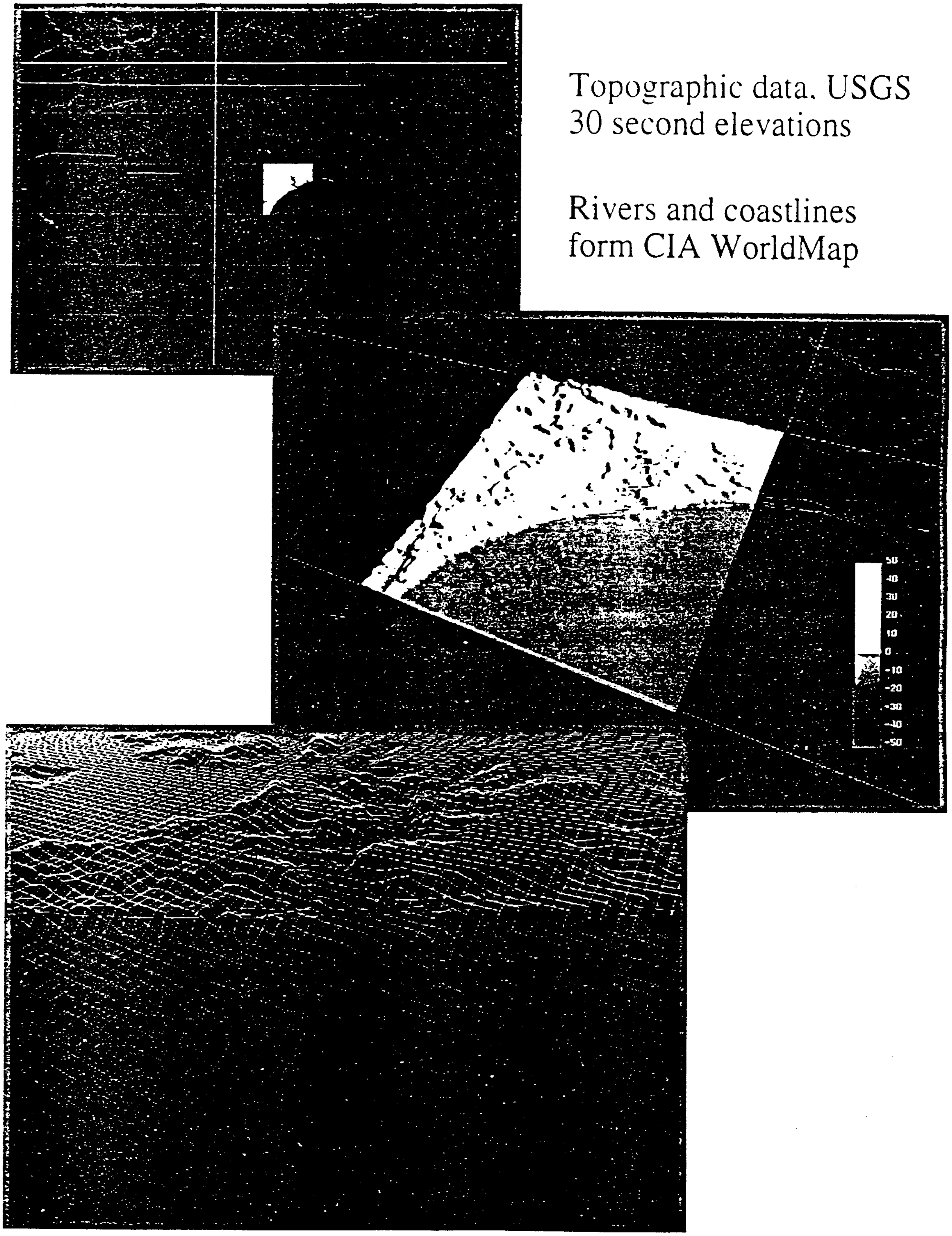
Mary Classon

1. Generate requests
2. DMA check
3. Acquisition

Topography for 34°-35°N 77°-78°W

Topographic data. USGS
30 second elevations

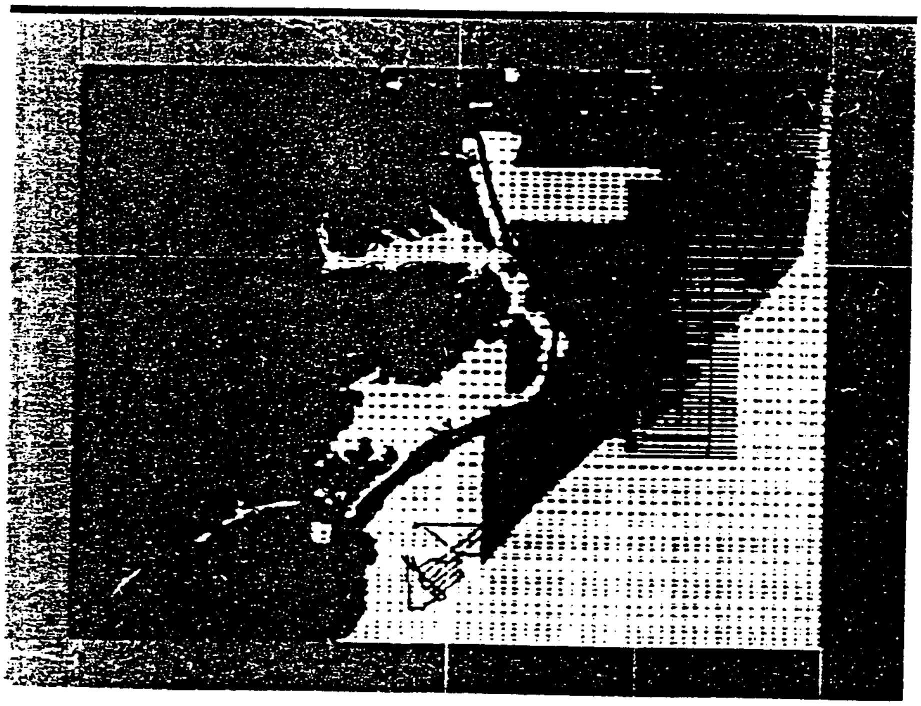
Rivers and coastlines
form CIA WorldMap



storm 6/13/94

Topography for 34-37N 74-78E from USGS 30 second evevations

Missing values shown in red



The SceneObject Framework Design

Bill Hess
Applied Physics Laboratory
University of Washington

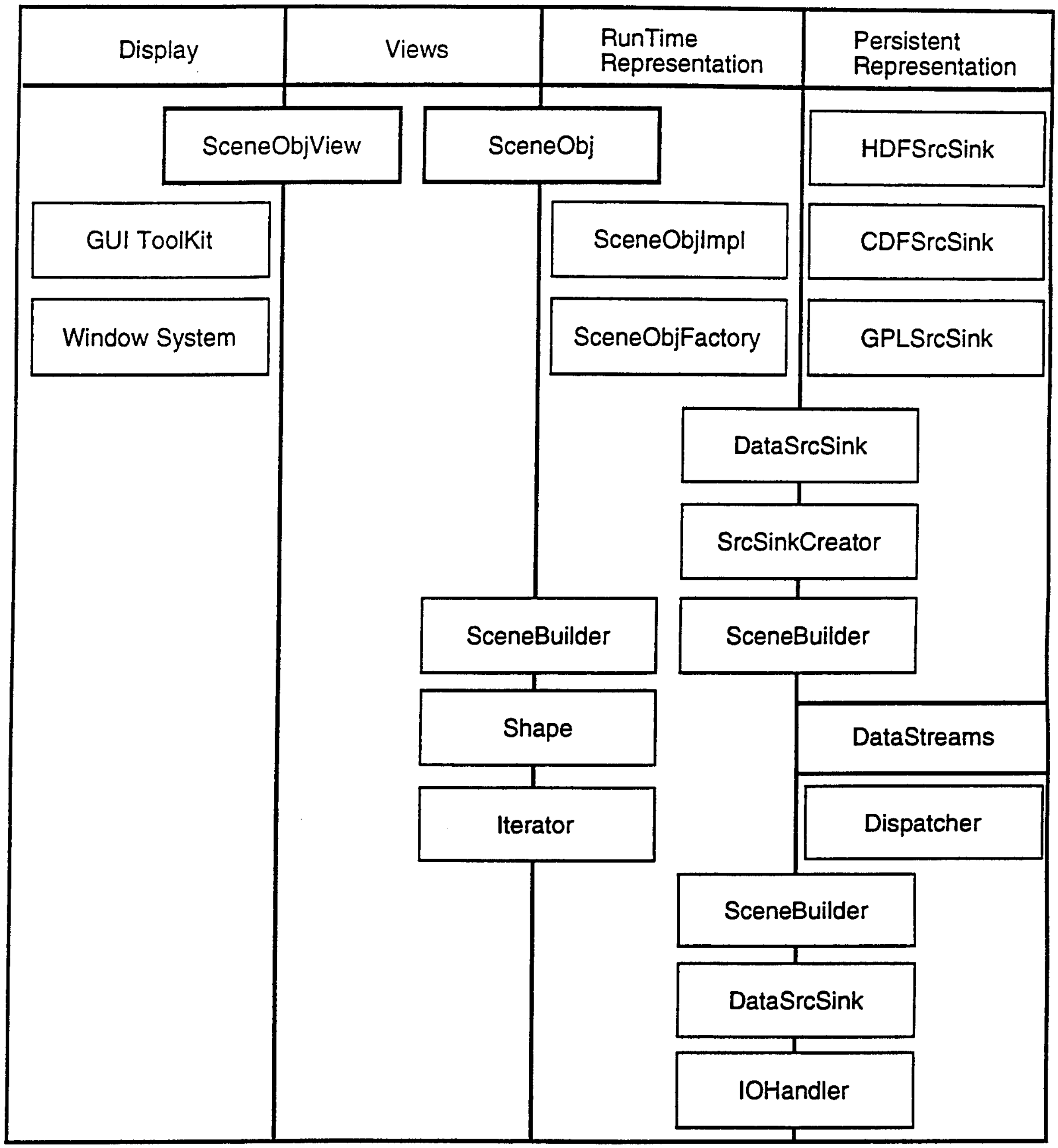
1 Objective

Design a system of C++ classes for the representation, manipulation, and display of spatially distributed coastal scene description data.

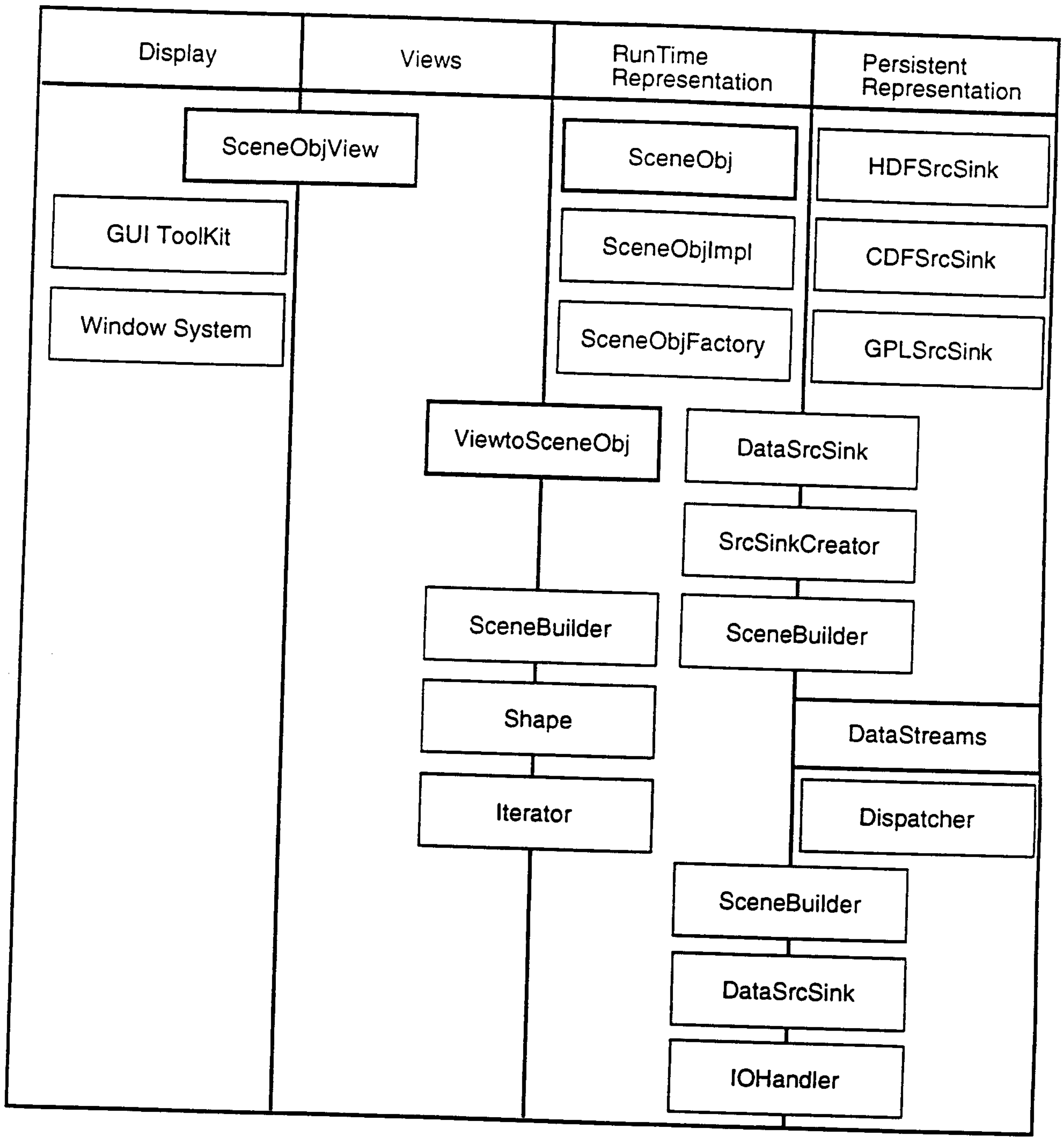
2 Design Principles

1. Favor composition over inheritance.
   - Avoids *class explosion*
   - Allows us to adapt the system at link and run times.
2. Hide object instantiation from application code.
   - Allows us to minimize the effect of extending the set of objects in the system.
3. Separate object interface from its implementation.
   - Allows us to change representation and algorithms without changing the application code or recompiling.
4. Hide the persistent form of the data from the application.
   - Allows us to change, add, and interchange data formats without reworking the application code.
5. Separate objects' representation from their display.
   - Allows multiple views of the data.
   - Supports views on multiple platforms.
   - Makes objects platform independent.
6. Support adaptive resolution.
   - Good performance when zooming and panning large dense data sets.
   - Matches the resolution of the data to that of the display. Avoids:
     - Aliasing from over plotting the display resolution
     - *Blocky* displays from under plotting display resolution.

3 Overall Architecture

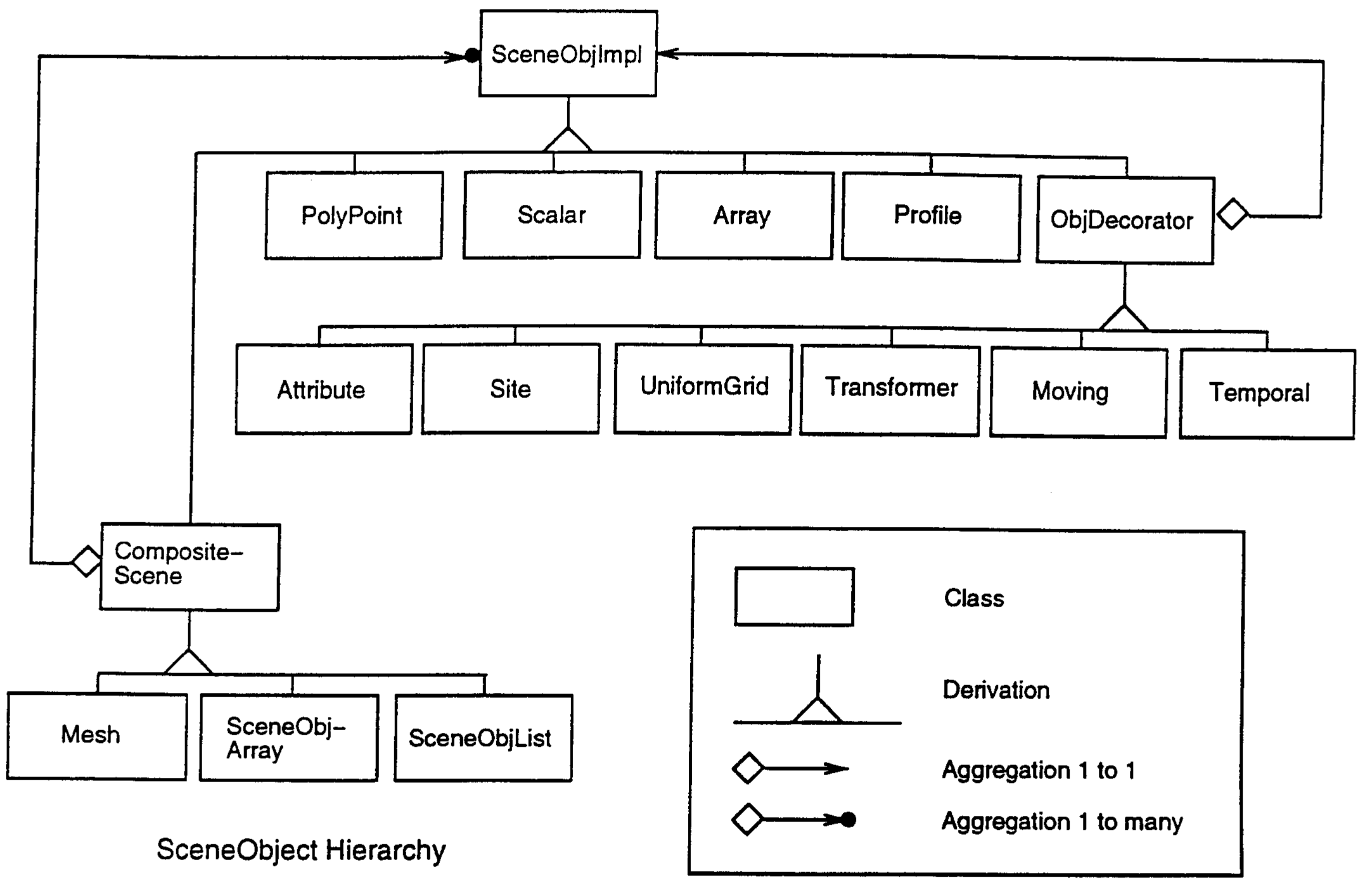


Architecture with Model View Implementation



Architecture with Mediator Implementation

5 SceneObjects



SceneObject Hierarchy

SceneObj The base class for all other scene description classes. This class provides a common interface to the classes in this hierarchy.

- **PolyPoint** A polygon used for representing areas on a plane; land masses for example.
- **Scalar** Represents a floating point scalar measurement at a single location; depth for example.
- **Array** An N-dimensional array of floating point values ($N \leq 8$).
- **Profile** An depth profile or time series of measurements at a single location. The number of parameters and the number of samples is arbitrary.

8 SceneObj Interface

```
class SceneObjImpl : public utBody {
public:
  virtual ~SceneObjImpl();

                                    // cloning and copying
  virtual SceneObj clone(int deep = 0) const = 0;
  void copy(const SceneObjImpl*, int deep);

                                    // getting and setting location
  virtual void move_abs(const utPoint&);
  virtual void move_rel(const utPoint&);
  virtual void get_origin(utPoint&) const = 0;
  virtual utPoint get_origin() const = 0;
  virtual void get_bounds(utPoint& p1, utPoint& p2) const = 0;

                                    // request SceneObj shape
  virtual const Shape get_shape() const = 0;

                                    // containment and intersections
  virtual int contains(const utPoint&, double tol=0.0) const = 0;
  virtual int intersects(const utPoint& p1, const utPoint& p2) const = 0;

                                    // setting and getting MonoSceneObj bodies.
  virtual void body(SceneObj&);
  virtual SceneObj body();
                                    // composite SceneObj operations
  virtual void insert(SceneObj&);
  virtual void append(SceneObj&);
  virtual void merge(SceneObj&);
  virtual void lazy(int yesno);
  virtual int lazy() const;
  virtual void remove(SceneObj&);
  virtual void clear();
  virtual int member(const SceneObj&) const;
  virtual int nelements() const;
```

```
                                          // accessing values
  virtual void set_array(utArray<double>& v, const utSlice&);
  virtual utArray<double> get_array(const utSlice&);

                                          // iterator creation
  virtual FaceItr createFaceItr();
  virtual EdgeItr createEdgeItr();
  virtual ArrayItr createArrayItr(const utSlice&);
  virtual PointItr createPointItr();
  virtual SceneObjItr createSceneObjItr();
  virtual SceneObjItr create_traversal(const utString& type);

                                          // Attributes
  virtual void set_attributes(AttrCatalog*);
  virtual AttrCatalog* get_attributes();

                                          // coordinate transformations
  virtual void push_transform(const utTransform&);
  virtual void transfrom(const utTransform&);
  virtual pop_transform();
  virtual const utTransform* current_transform() const;

                                          // loading and storing objects
  virtual int load(DataSrcSink*);
  virtual int save(DataSrcSink*);

                                          // object liveliness
  virtual int active();

                                          // object identity
  virtual void id(int ident);
  virtual int id();
};
```

9 Example

9.1 SceneObject Registration

Here is an example of using the SceneObjFactory to build a registry of SceneObjs. Notice that some of the objects are built from composites of others:

```
static void init()
{
  SceneObjFactory* f = SceneObjFactory::instance();

  f->register_obj("SceneObjList", SceneObj(new SceneObjList));
  f->register_obj("Scalar", SceneObj(new Scalar));
  f->register_obj("NullObj", SceneObj(new NullObj));
  f->register_obj("Site", SceneObj(new Site));
  f->register_obj("Mesh", SceneObj(new Mesh));
  f->register_obj("Ident", SceneObj(new Ident));

  SceneObj scalar = f->create_obj("Scalar");
  SceneObj scalar_site = f->create_obj("Site");
  scalar_site->body(scalar);
  f->register_obj("ScalarSite", scalar_site);
}
```

9.2 SceneObj Creation

Now we create a composite using the registered objects. However, the code below does not need to know what kind of composite it is building, or what kind of objects it is creating. We want to add an identifier to the objects in the composite so we build attach an object identifier feature on the fly:

```
static SceneObj create_composite(int n, const utString& comp_type,
                                        const utString& obj_type)
{
  SceneObjFactory* f = SceneObjFactory::instance();
  SceneObj comp = f->create_obj(comp_type);
  SceneObj proto = f->create_obj(obj_type);
  SceneObj ident = f->create_obj("Ident");

  if (comp != 0 && proto != 0 && ident != 0) {
    int i;
    utArray<double> v(1);
    comp->lazy(1);

    for (i = 0; i < n; ++i) {
      SceneObj s = ident->clone(1);

      s->body(proto->clone(1));
      s->id(i);
      v(0) = uniform();
      s->set_array(v, utSlice());
      s->move_abs(get_coord());
      comp->insert(s);
    }
    comp->lazy(0);
  }
  return comp;
}
```

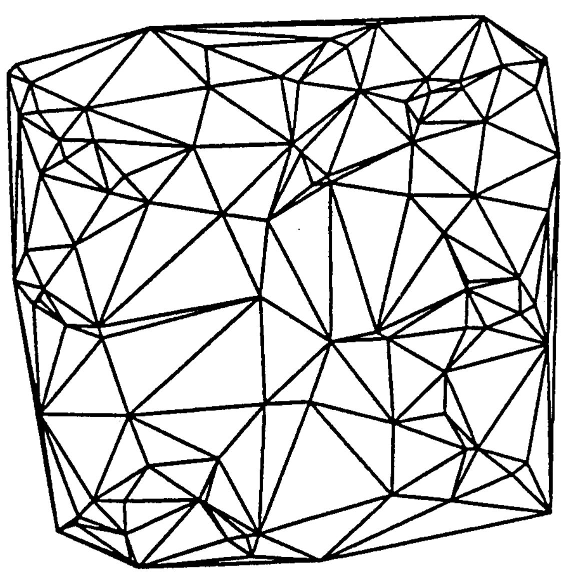
9.3 Iteration

Finally we want to plot out resulting structure. We are passed an iterator, but we don't really care where it comes from:

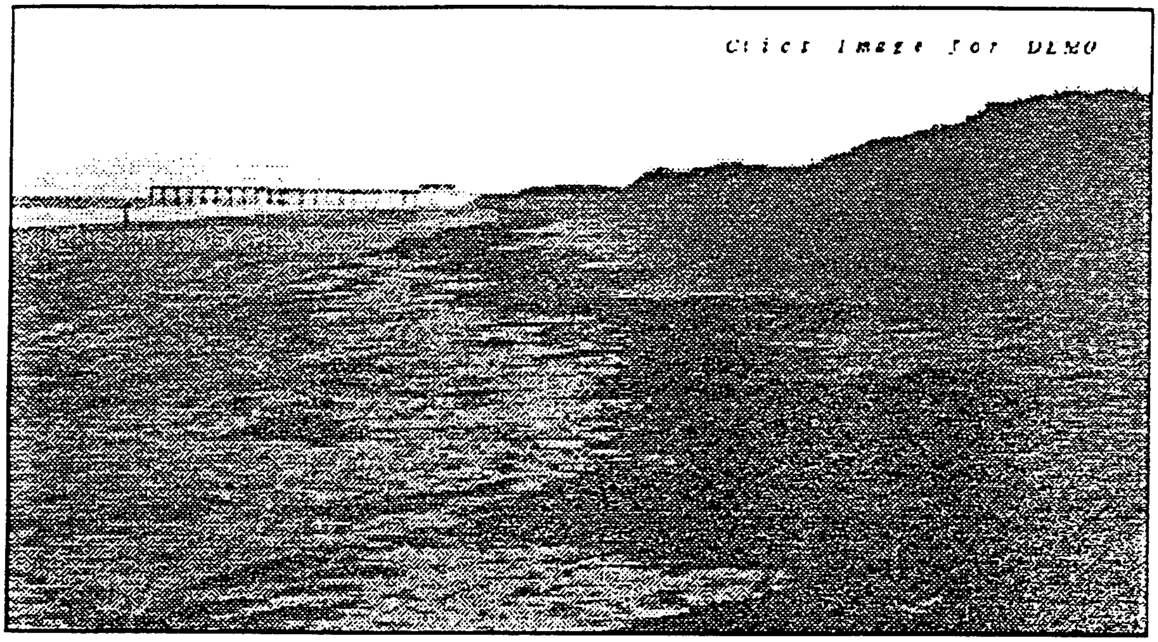
```
static void plot_faces(FaceItr& itr, Render& r)
{
  r.push_color(rdColor(0.0, 0.0, 0.0));
  for (; itr->more(); itr->next()) {
    Edge* e = itr->current();

    r.new_path();
    r.move_to(e->org()->get_origin());
    r.line_to(e->dest()->get_origin());
    r.line_to(e->onext()->dest()->get_origin());
    r.close_path();
    r.stroke();
  }
  r.pop_color();
}
```

9.4 Result



SHORES : SHOre-zone data RESolution



SHORES Program Information

Research Overview

Click on picture above or options below.

- General Info. (slide show)
- Research Documentation
  - Research Plan
  - Research Documentation
  - Findings
- Demostration Environment

Software Environment

- Data Exchange
  Provides interactive selection and transfer of digital MC&G data sets for MAB/LWTC regions. Click here for documentation or data exchange button above to execute software.
- Data Integration
  Provides methods for integrating multi-source/multi-resolution MC&G data with user specified data. Click here for documentation or data integration button above to execute software.
- Error/Conflict Analysis
  Provides methods for indentifying errors and conflicts associated with data integration. Click here for documentation or error analysis button above to execute software.
- Deconfliction Tools
  Provides methods for resolving errors and conflicts. Click here for documentation or

deconfliction button above to execute software.

References

- Data Reduction and Error Analysis for the Physical Sciences

---

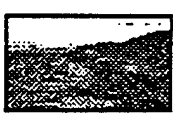
 Return to SHORES HomePage

 Return to GIS Research HomePage

Data Exchange

Master MAB/LWTC Data Library

- Bathymetry
  - 5 minute World Topography......................IMAGE
  - 5 minute World Relief...............................IMAGE
  - 30 second USGS Topography.....................IMAGE
  - 30 second USGS Relief.............................IMAGE
  - NOAA East U.S. Bathymetry contours......IMAGE
  - NOS 15 second point Bathymetry.............IMAGE
- Shoreline
  - 1:30000000 Browse Shoreline...................IMAGE
  - 1:250000 World Vector Shoreline.............IMAGE
  - 1:80000 East U.S. NOS Shoreline.............IMAGE
- Cultural
  - East U.S. USGS Roads..............................IMAGE
  - East U.S. USGS RailRoads.......................IMAGE
  - East U.S. USGS Rivers............................IMAGE
  - East U.S. USGS Political Boundaries.......IMAGE
- Geophysical
  - North America Gravity.............................IMAGE
- Digital Chart of the World Data
  - Political and Ocean Boundaries................IMAGE
  - Hypsography and Ocean Feature Data.......IMAGE
  - Supplemental Hypsography Line Data......IMAGE
  - Supplemental Hypsography Point Data.....IMAGE
  - Cities..IMAGE
  - Populated Places.......................................IMAGE
  - Roads..IMAGE
  - Vegetation Data..IMAGE
  - Hypsography Data.....................................IMAGE

 Return to SHORES HomePage

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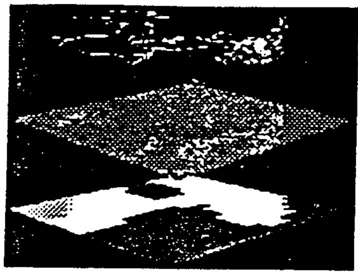
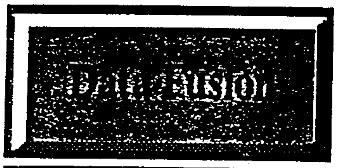


Data Integration Process

Input Data + Integration Process = Output Data



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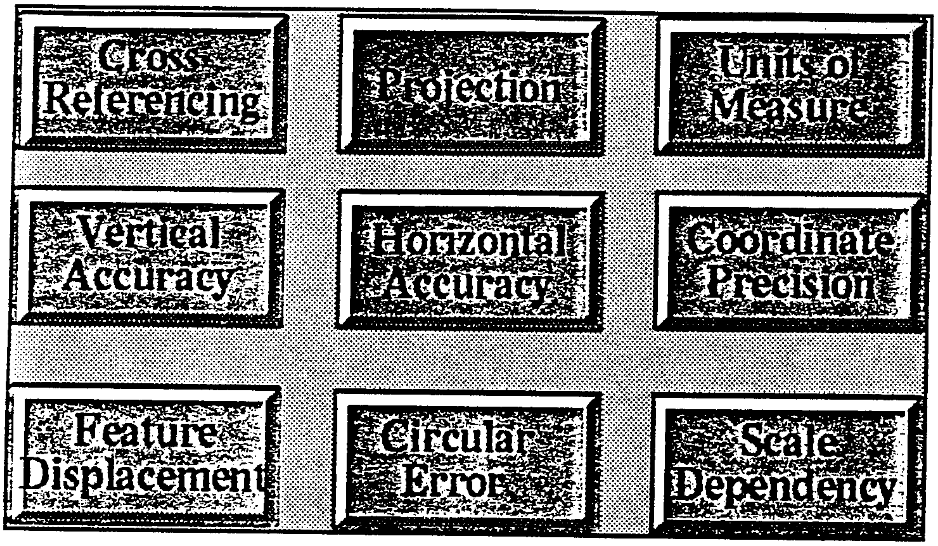
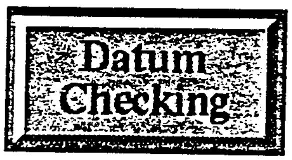
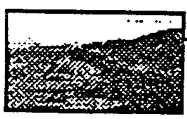
Error/Conflict Analysis Tools





 Return to SHORES HomePage

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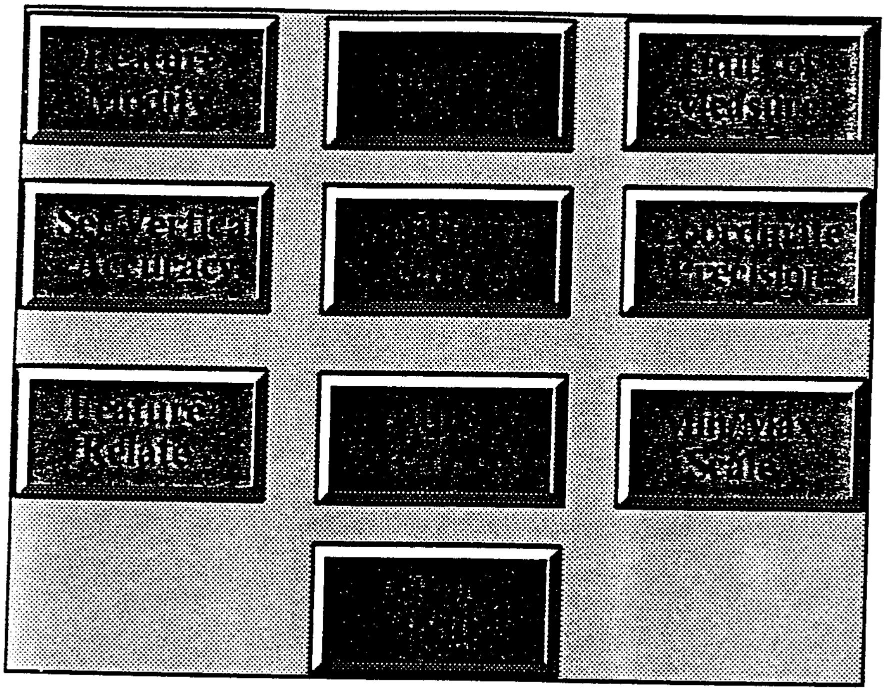
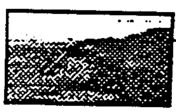
Deconfliction Tools

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Tactical Oceanography Simulation Laboratory (TOSL)

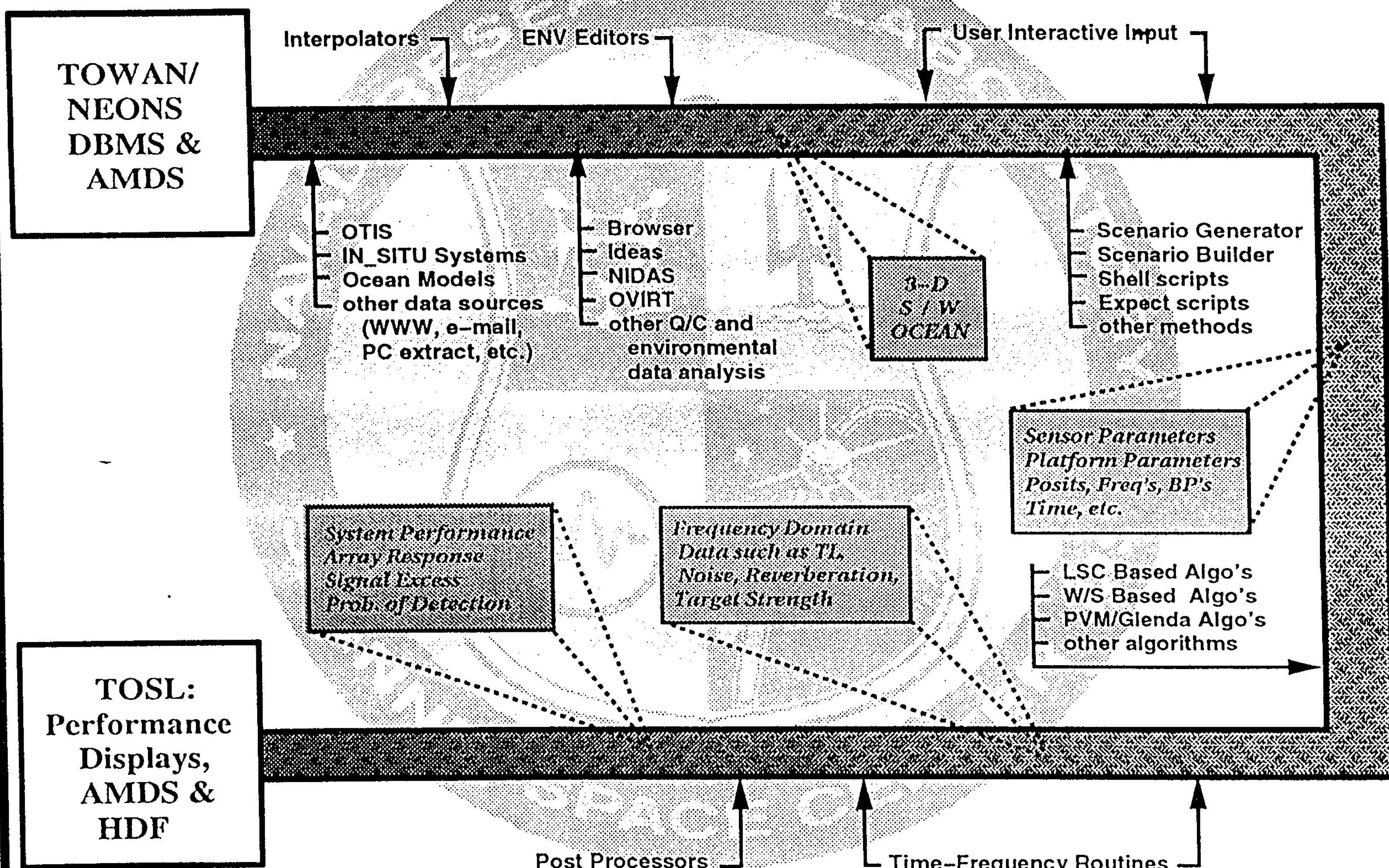
OBJECTIVE

- Demonstrate the efficiency of exact computer recreations and simulations applied to sensor weapons and related environmental acoustic issues.
- Apply the laboratory capability over the 3–5 orders of magnitude that span MIW/MCM through all ranges of USW systems to include the lowest 10 Hz mine sweeping technologies.
- Support mission rehearsal, system acquisition and training in both real and realistic environments.

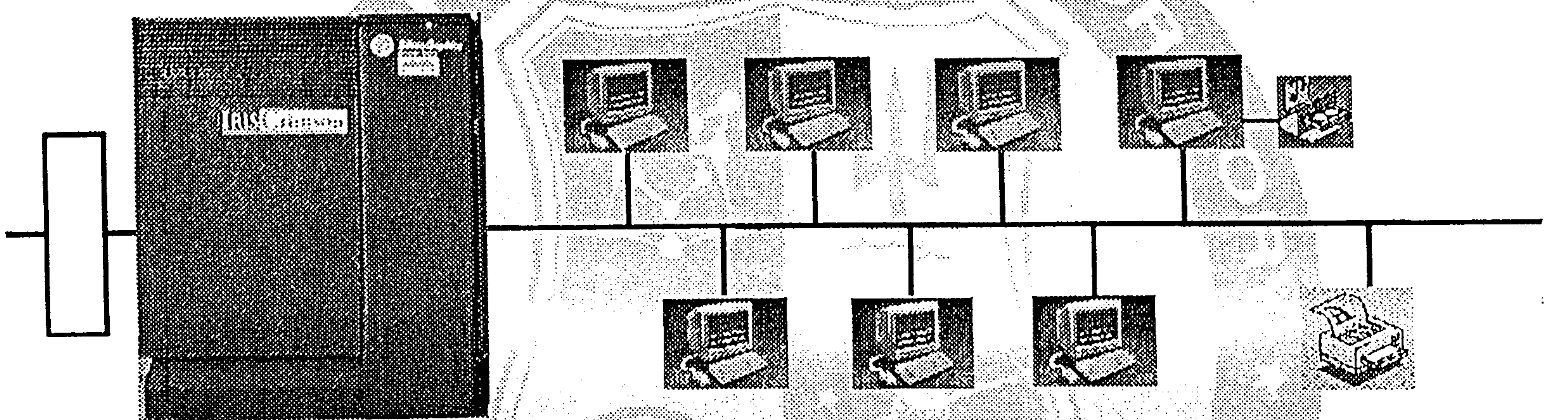
APPROACH

- Develop an advanced computer graphics applications facility utilizing the acoustic simulation development algorithm(s) for computation.
- Establish network connections to super computing capability.
- Develop practical user oriented interface to LSC based simulation algorithm.
- Develop graphic displays that rapidly and accurately replicate real environmental acoustic data, model calculations and sensor/system characteristics.

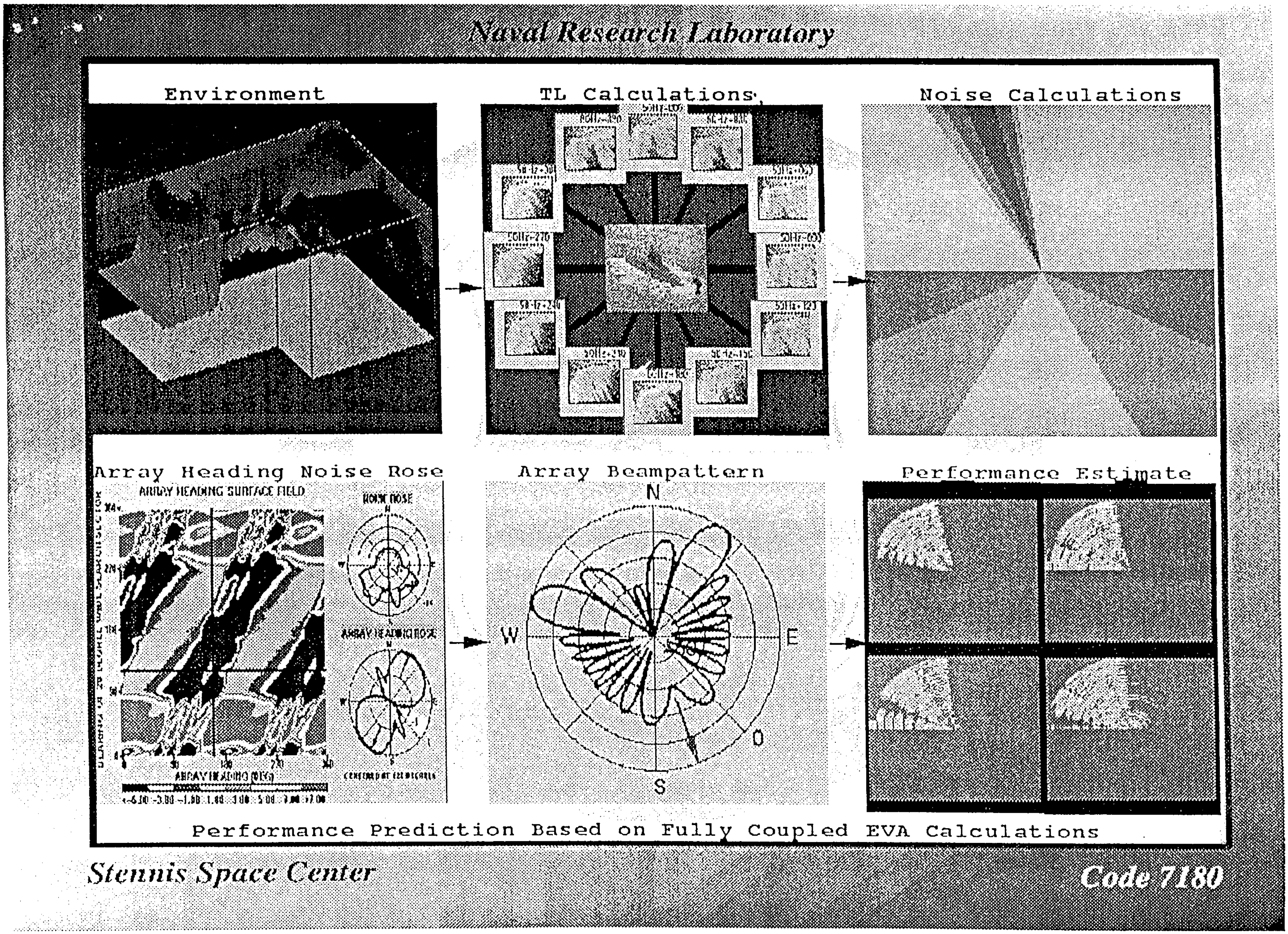
TOWAN/TOSL Information Flow



TOSL HARDWARE LAYOUT



1 Crimson (file server)
6 Programmer Indigos
1 Common Indigo
Cisco Router & Tek DS


Naval Research Laboratory
Environment
TL Calculations
Noise Calculations
Array Heading Noise Rose
ARRAY HEADING SURFACE FIELD
NOISE ROSE
ARRAY HEADING ROSE
ARRAY HEADING (DEG)
Array Beampattern
N
W
E
S
Performance Estimate
Performance Prediction Based on Fully Coupled EVA Calculations
Stennis Space Center
Code 7180

Summary and Conclusions

- TOSL = suite of independently developed *cooperating* modules/processes to manage TACO information flow and to provide interactive 3–D graphics
- TOSL allows "niche" experts & expertise to *join* other experts (env, modelling, acoustics, GUI, graphics, ...) quickly and efficiently to explore EVA issues.
- TOSL provides *access* to the "best" available data sources, be they benchmark, experimental, modelled, Navy standard, user supplied, ...
- TOSL uses information flow and modular software to yield:

seamless end–to–end integration of research products for the purposes of exploratory development

APPENDIX D

DEMONSTRATION & MINIWORKSHOP
NRL/SSC
26 OCT 94

HARVARD OCEAN PREDICTION SYSTEM

AGENDA

ATTENDEES

HANDOUTS

1) Harvard Ocean Prediction System Description

2) A System of Integrated Algorithms For The Efficient Estimation of Oceanic Fields VIA the Fusion of Data and Dynamics

CSD MINIWORKSHOP

CSD NOTES

Demonstration

HARVARD
OCEAN PREDICTION SYSTEM

0900
Wednesday, October 26

NRL Conference Room
Building 1005 Room A32

Harvard Ocean Prediction System Demonstration
26 October 1994

0900 Welcome

Dr. George W. Heburn
NRL
Ocean Prediction and Dynamics Branch

0910 Demonstration Overview

Dr. Allan R. Robinson
Harvard University

0920 Demonstration

Harvard Ocean Prediction System

Wayne Leslie
Harvard University

1010 Discussion

1020 Remarks

Mr. Robert Peloquin
ONR
Ocean, Atmosphere, and Space Department

Harvard Ocean Prediction System Demonstration
Coastal Scene Description Mini-Workshop
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
26 October 1994

NAME/EMAIL	ORGANIZATION	PHONE COM DSN / FAX	SIGNATURE
Arango, Hernan ARANGO @ PACIFIC.HARVARD.EDU MODS @ " " "	HARVARD	(617) 495-3457	[signature]
Breckenridge, John jbreck@dittohd.nrlssc.navy.mil	NRL	(601) 688-485-5224/4853	[signature]
Crowley, Mike crowley@~~caribbean~~ atlantic.rutgers.edu	RUTGERS	908-932-6555 X543	Michael F Crowley
Dantzler, Lee dantzhl1@jhuapl.edu	JHU/APL	(301) 953-5387/6667	
Glenn, Scott glenn@caribbean.rutgers.edu	RUTGERS	(908) 932-6555 X544/1821	
Harris, Portia harris@nrlssc.navy.mil	NRL	(601) 688-485-5787/4759	P Harris
Heburn, George heburn@nrlssc.navy.mil	NRL	(601) 688-485-5448/4759	[signature]
Kerr, Keith keith@anchor.apl.washington.edu	APL/UW	(206) 543-1268/685-4404	[signature]
Leslie, Wayne leslie@pacific.harvard.edu	HARVARD	(617) 495-4569/5192	Wayne Leslie
Lozano, Carlos LOZANO @ PACIFIC.HARVARD.EDU	HARVARD	(617) 495-9807	C Lozano
Mack, Stephen steve_mack@jhuapl.edu	JHU/APL	(301) 953-6478 FAX 953-6908	[signature]
Miyamoto, Robert rtm@apl.washington.edu	APL/UW	(206) 543-1303/6785	[signature]
Peloquin, Robert	ONR	(703) 696-226-~~6463~~ 6462/3390	[signature]
Robinson, Allan robinson@pacific.harvard.edu	HARVARD	(617) 495-2819/5192	
Scheerer, David dsj@stdc.jhuapl.edu	JHU/APL	(301) 953-~~0000/1093~~ 6000 6908 x8754	David Scheerer

The Harvard Ocean Prediction System

Harvard Oceanography Group
Division of Applied Sciences
Department of Earth and Planetary Sciences

System software is available upon request to:

Allan R. Robinson, ***Principal Investigator***
robinson@pacific.harvard.edu

Hernan G. Arango, ***Lead Scientist***
arango@baltic.harvard.edu

System Description

The Harvard Ocean Prediction System (HOPS) is a computer-based system designed to provide

a) for the naval ocean forecaster accurate estimates of ocean fields in a timely and reliable manner;

b) for the physical oceanography scientist realistic simulations of the ocean in order to study fundamental dynamical mesoscale processes;

c) for the acoustical oceanography scientist tools to obtain reliable representations of the mesoscale sound speed variability;

d) for the bio-geochemical oceanography scientist an integrated environment to carry out coupled physical-bio-geochemical model simulations.

HOPS is an on-going project at the Harvard University sponsored by the Office of Naval Research. The system represents the structuring of experience gained by the Harvard group in ocean forecasting and simulations since 1984. During this period the group has conducted five real-time forecasting aboard ship exercises over the world oceans; maintained a quasi-operational forecast center for the Gulf Stream and Meander System (1987–1989); researched and developed practical data assimilation schemes and physical, and bio-geochemical models.

The system is designed to accommodate different needs. The HOPS configured as a nowcast/forecast system is designed to meet shipboard operational needs requiring adaptability to diverse datastreams and dominant physics in a given region, and has the ability to be exercised fully as a stand-alone system utilizing ship gathered information only.

The HOPS, configured as a research and training tool for physical oceanography scientists, facilitates the generation of physical fields suitable for process studies, and allows efficient exploration and exploitation of new algorithms and ideas.

The configuration of HOPS for interdisciplinary research is now under development. It is intended to provide a laboratory to investigate the influence of the physical environment on the evolution of oceanic bio-geochemical mass.

In order to accommodate these diverse needs the system is *portable, flexible* and *efficient.* These attributes are understood as follows:

> *Portable.* The system can be setup in arbitrary ocean regions where synoptic realizations with mesoscale resolution is well supported by data.
>
> *Flexible.* The system supports the use of various data types, remote and *in situ*, and it is setup for an optimal use of its information content by the system in a timely manner. The system contains a suite of intercompatible physical models with varying physics permitting the adaptation of the system to the dynamical regime of the targeted forecasting area. The system includes tools to construct regional observational and model climatology, statistical correlations of observables and model variables, and feature models.

The *efficiency* of the system requires:

a) *Robust and fast processing* in each system component, and reliable intercomponent communications.

b) *User interfaces* to guide system processes, especially data and forecast products, quality control and process troubleshooting.

c) *Visualization and display* tools to facilitate the scientific study of intermediate and final products.

d) *Interfaces* with other systems (acoustical, biogeochemical, management models, and geophysical fluid dynamics analysis tools).

Figure 1 shows a functional schematic of HOPS. The arrows indicate the main flow of information and the boxes contain activities and process products. The HOPS flow diagram includes other intercomponent connections not shown in Figure 1 for the sake of clarity. It is to be noted that the notion of a dynamical model as the centerpiece of the system is abandoned and emphasis is given to a synergetic view where judicious improvements of a system component benefit the overall system performance. Therefore, a particular configuration is tested for sensitivity and robustness of results using Observing System Simulation Experiments (OSSE). With this viewpoint in mind, a brief description of the system components and areas of current developments follows.

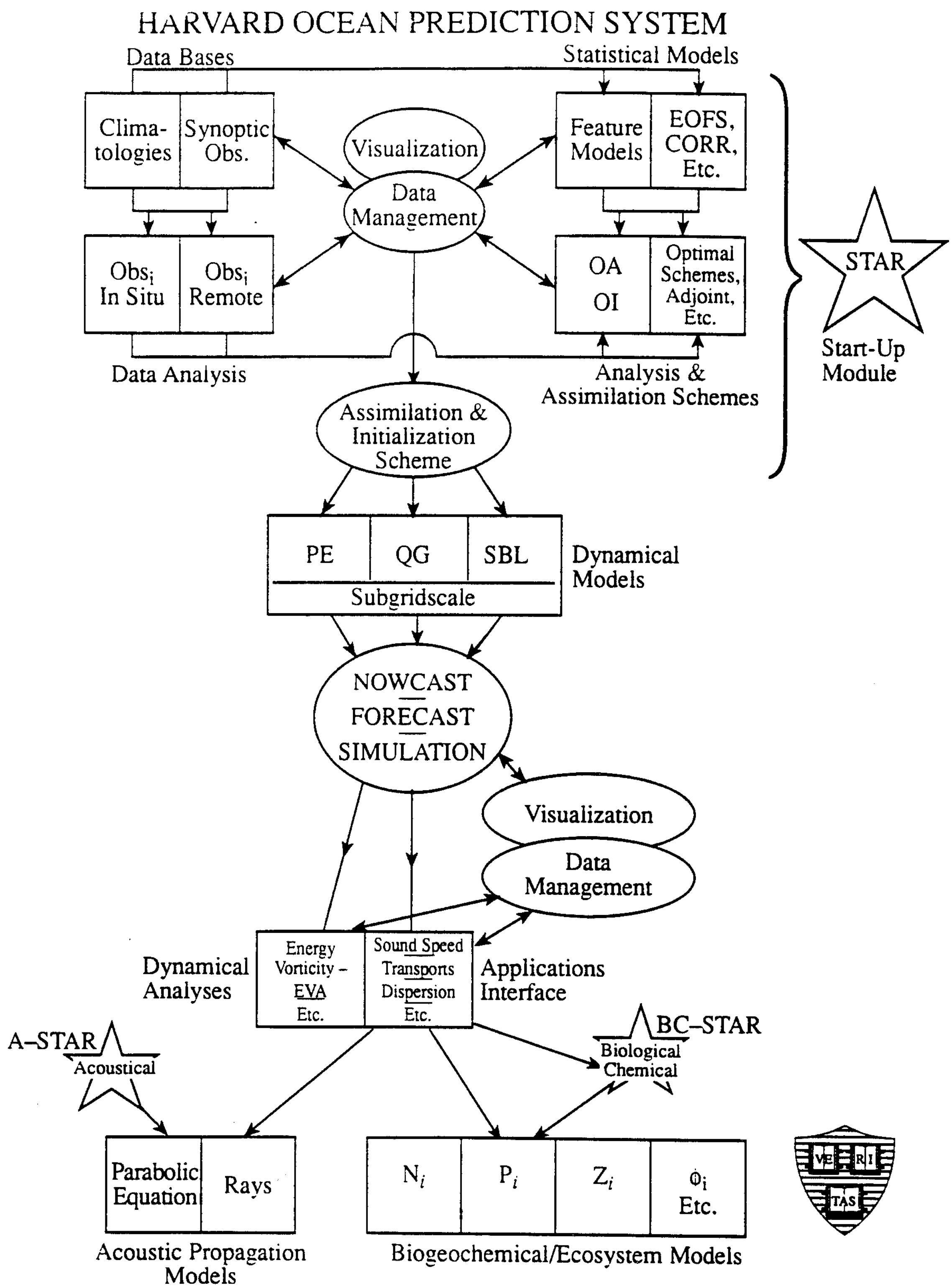
Statistical Database. This component embodies our previous knowledge of the region and previous system performance. This information is configured in a form suitable by use with other system components. The traditionally historical data for a region is complemented with statistical correlations between observables and model state variables, semianalytical synthesis of synoptic patterns (feature models), and empirical orthogonal functions.

In order to monitor the system skills, the statistical database must include measurements of model performance both for single forecasts and seasonal forecasts. In addition, there is a need to develop statistical indicators of the impact of observations to the system skill. This information is necessary in the development and design of cost-effective observational strategies.

Statistical Models in the system comprise the set of statistical based procedures to interpolate and extrapolate information to the model grid both in space and time. It is convenient to separate — as shown in Figure 1 — a set of exclusively statistically based procedures. This prepares the data for model ingestion from those mixed statistical-dynamical procedures here referred to as assimilation schemes. Optimal analysis EOF vertical extensions, cross correlations, combined optimal analysis and feature models, and water mass models are part of the statistical tools available in the system.

Dynamical Model Set. In the system, this is a set of dynamical models amenable to configuration with physics suitable to the region dynamics for interpolation, adjustment (nowcasting) and forecasting.

The suite of the Harvard dynamical models includes a primitive equation model for regional forecasting, a baroclinic quasigeostrophic model for open domains and semi-enclosed seas or ocean regions with or without islands. The quasigeostrophic model has in addition



HARVARD OCEAN PREDICTION SYSTEM
Data Bases
Statistical Models
Clima-tologies
Synoptic Obs.
Visualization
Data Management
Feature Models
EOFS, CORR, Etc.
Obs_i In Situ
Obs_i Remote
OA OI
Optimal Schemes, Adjoint, Etc.
Data Analysis
Analysis & Assimilation Schemes
STAR
Start-Up Module
Assimilation & Initialization Scheme
PE
QG
SBL
Subgridscale
Dynamical Models
NOWCAST
FORECAST
SIMULATION
Visualization
Data Management
Dynamical Analyses
Energy Vorticity - EVA Etc.
Sound Speed Transports Dispersion Etc.
Applications Interface
A-STAR
Acoustical
BC-STAR
Biological Chemical
Parabolic Equation
Rays
N_i
P_i
Z_i
Φ_i Etc.
Acoustic Propagation Models
Biogeochemical/Ecosystem Models

a module to include surface boundary layer physics, and within this module a biological module can be attached. The quasigeostrophic model can be used for initialization with data of the primitive equation model in the slow manifold.

The dynamical model interconnectivity can be achieved in nested domains with one- and two-way interaction. The latter now under development is intended to provide an avenue to resolve multiscales.

The quasigeostrophic model and the primitive equation models include a suite of codes to track drifters and passive tracers.

Energy Vorticity Analysis. Ocean mesoscale is eventful; consequently, there is a need to provide the ocean forecaster with tools to recognize and monitor these events in order to improve the forecaster's skills. Energy and vorticity analysis of events are tailored to operational needs, providing a powerful addition to the ocean forecaster's tool kit.

Data Assimilation strategies in a forecast system provide the means for model initialization and update, melding model fields and primary data, tuning of model physical parameters, and providing error estimates.

In a traditional view the dynamical model and the data assimilation schemes act in parallel — the former providing dynamical adjustment and evolution, the latter improving estimates of model fields and updating error estimates. In this sense, the assimilation scheme provides corrections externally to the model. Techniques based upon sequential estimation (optimal interpolation) are available in the system. Sequential estimation provides a time history of fields in dynamical adjustment and error evaluation interrupted by corrections introduced by the assimilation scheme. In distinction, the adjoint method yields a *continuous* history of dynamically balanced fields, and optionally with improved model physical parameters. In either case, it is possible to design strategies for which the time evolution of fields is mostly dominated by the dynamics enabling dynamically consistent approximations to the data. These fields can then be fruitfully used in forecast and dynamical studies. The method of the adjoint for the quasigeostrophic model which has been constructed and utilized in data assimilation studies (Moore, 1991), will be integrated into the system.

The time evolution of error fields is connected with the time evolution of the moments of physical fields and the theory to estimate their evolution is not well developed yet. These error growth estimates are needed within the forecast system to facilitate forecast quality control and evaluation and to aid in the design of cost-effective observational strategies.

As part of the interdisciplinary efforts at Harvard, interfaces for acoustical models with the primitive equation and the quasigeostrophic model have been constructed, and biogeochemical models are now attached to the quasigeostrophic-surface boundary layer model. These model components are integrated into HOPS. The acoustical models are exercised routinely in shipboard exercises.

Software Summary and Software Attributes

In this section a succinct summary of the Harvard Ocean Prediction System (HOPS) software and its attributes is provided.

System Components

The system modules are implemented in FORTRAN77. The source code is in compliance with the standard. The source code and ancillary files are maintained using the SCCS utility. Executables are created using the MAKE utility. In addition to the libraries associated to standard FORTRAN compilers the system uses the following libraries: NetCDF, GKS/NCAR graphics, PPLUS, IBM data explorer and PVM.

Data Format

The designated primary data format is NetCDF supported and freely distributed by Unidata/UCAR. The migration to this data format for all the datasets is near completion.

System Modularity

Modularity is achieved by restricting a module to accomplish a simple set of tasks with minimum inputs and outputs, and keeping, within each module, isolated input/output interfaces. This permits rapid exchange and replacement of modules.

Software Portability

The system modules are fully supported presently in the following hardware platforms:
SUN, DEC, IRIS, CRAY (YMP, C90)

Import/export of NetCDF to other commonly used data formats or database management systems is widely supported. Postprocessing tools for NetCDF files (graphics, data base management system functions, etc.) are readily available in the network.

Software Performance and Robustness

Extensive use of the system in real time and in the laboratory shows robust results. The entire forecasting procedures were accomplished in about three hours clocktime in the Iceland-Faeroe Frontal region.

Graphics

The system uses and supports utilities for the following graphics packages:
NCAR GKS, IBM DX, PPLUS, and MATLAB.

The visualization/animation of data using IBM Visualization Data Explorer has been recently initiated. The first generation of products using this tool is under development.

Datasets

- Bathymetry (TOPO5/NOAA)
- Coastlines (CIA)
- Climatologies: TS (Levitus, Robinson-Bauer, Hellerman-Rosenstein); Atmospheric forcing for the Mediterranean Sea (May, Gilman-Garrett); E-P (Ooort); p (Yaggear); Heat Fluxes (ECMWF, FNOC and NMC).
- NAVOCEANO XBT (91,92 Mediterranean Sea)
- NAVOCEANO Floats 92,93 Mediterranean Sea)
- CTD, XBT (NODC, all data sets).

- Winds (FNOC, ECMWF)
- Atmospheric fluxes (FNOC, ECMWF)
- Eastern Mediterranean POEM hydrography datasets (85,86,87,91,93).
- GULFCAST datasets (1987–1989)
- GEOSAT altimetry.
- TOPEX/POSEIDON datasets (all).
- MODE and POLYMODE datasets (all).
- JGFOS–91 dataset.
- CTD/XBT IFF (NAVO, SACLANT 87,88,89,91,92,93) datasets.
- MARMAP/FISHERIES datasets.
- GEOSECS dataset.
- TTO (NAS and TAS) dataset.
- SYNOP dataset.
- BIOSYNOP dataset.
- CTD OPTOMA.
- CTD/XBT AthenA.

Statistical Models

Multivariate Objective Analysis Package(OA). Includes a generic and a suite of specialized OA modules.

Single and Multiscale Feature Models for data synthesis, model initialization and data assimilation schemes.

Empirical Orthogonal Functions Schemes for data reduction, vertical extension, interpolation and couplings with interdisciplinary models.

Dynamical/Biological Model Components

Primitive Equation Model with terrain following coordinates including tall or steep topography, and open/closed/semi-enclosed boundaries.

Quasigeostrophic Baroclinic Model for open/closed/semi-enclosed regions. *Bulk Surface Boundary Layer Module* attached to the quasigeostrophic model.

Four Compartment (Phytoplankton, Heterothrops, Nitrate, Ammonium) Biological Module imbedded in the surface boundary layer module.

Energy Vorticity Analysis Modules to construct vorticity and energy balances for quasigeostrophic and primitive equation fields.

Lagrangian Drifters Modules imbedded in the quasigeostrophic model and the primitive equation models.

Passive Tracers Modules imbedded in the quasigeostrophic model and the primitive equation models.

Ray Tracer Model from Scripps.

2D and 3D Parabolic Equation Acoustical Models from NUSC.

Data Assimilation

Intermittent Assimilation Modules imbedded in the quasigeostrophic and Primitive Equation Models. Presently the Intermittent Assimilation module exercises an Optimal Interpolation Algorithm.

Adjoint Assimilation Module imbedded in the quasigeostrophic model.

Harvard Ocean Prediction System (HOPS)

A SYSTEM OF INTEGRATED ALGORITHMS FOR THE EFFICIENT ESTIMATION OF OCEANIC FIELDS VIA THE FUSION OF DATA AND DYNAMICS

Elements:

- **Databases and Data Streams**
- **Data Analysis Schemes**
- **Statistical Models**
- **Data Assimilation Schemes**
- **Dynamical Models**
- **Dynamical Analysis Schemes**
- **Applications Interfaces**
- **Data Management Tools**
- **Visualization Tools**
- **Fields - Space, time distribution of oceanic variables**

Field Estimates and Products

Accurate three-dimensional fields with time evolutic

Field estimates via data assimilation

Melded data and dynamics for efficient, accurate and realistic estimates

Nowcasts

Best present estimate with past and present data and dynamics

Forecasts

Nowcast projected forward in time via dynamics

Hindcasts and data driven simulations

Estimate at a given time utilizes past and future data to provide most realistic estimate possible

Physical fields (v,p,T,S); Acoustical, biological and chemical fields

Vorticity and energy balances, primary productivity, etc.

Domains of Application

A rapidly deployable, relocatable system

Any region of the world ocean of interest

Open, partially open or closed domains

Operational model
  Arbitrary vertical coasts for shelf or deep ocean

Research/Operational Model
  Any region, including across the shelf break

Domains for resolution of multi-scale processes:
Nested subdomains for local higher resolution

- Operational Model
  - One-way nesting
- Research/Operational Model
  - Two-way nesting

Methods of Estimation and Modes of Application

System allows immediate extraction of a relevant configuration for a specific application

Configuration considerations:

- Operational or research application
- Technician or scientist user
- Desired final product
- Regional dynamics
- Data resources
- Logistical considerations
  - Real-time, shipboard forecasts
  - vs. laboratory simulations

Sample configurations:

1. Hydrography - OA - nowcast/forecast
   e.g. rapid assessment
2. Satellite altimetry - OA/EOF - nowcast/forecast
   e.g. no *in situ* data, continued updating
3. Satellite altimetry - feature model - nowcast
   e.g. no *in situ* data, rapid assessment

Example configurations:

4. Iceland/Faeroes Front
5. JGOFS - NE Atlantic spring bloom
6. Western North Atlantic

1993 Iceland-Faeroes Front Experiment

- Initialization and updating with substantial resources
  - CTD's, XCTD's, XBT's
  - ARGOS tracked surface drifters
  - Feature Model
- Primitive Equation Model
- Coupled QG-SBL Models, Parabolic Equation Acoustic Propagation model
- To Demonstrate:
  - Shipboard forecasting in real-time with data assimilation
  - Model forecasting verification
  - Acoustic propagation forecasting
  - Prediction and assimilation of drifter data
  - Observational System Simulation Experiment (OSSE)
- Film Clips:
  - Domain, model set-up, observations
  - Temperature evolution
  - Lagrangian trajectories
  - Surface Boundary Layer forecasting

1989 JGOFS Spring Bloom Experiment

- Initialization with minimal resources
  - GEOSAT
  - AXBT's
  - Feature Model
- Coupled QG-SBL-Biological Model
- To Demonstrate:
  - Biological Dynamics
  - Physical-Biological Interactions
- Film Clips:
  - Nitrate
  - Phytoplankton
  - Zooplankton

Western North Atlantic: GS, Slope, MAB

- Initialization and updating with minimal to substantial resources
  - OTIS
  - Multiscale Feature Model (MSFM)
  - GEOSAT, IR SST, CTD's, AXBT'S
- Primitive Equation Model
- To Demonstrate:
  - Nowcasting and forecasting with a selection of assimilation and initialization schemes
  - OTIS, Multiscale Feature Models, direct data streams
  - Dynamical model validation, calibration and verification
  - Hindcasting across shelf break of coupled shelf and deep oceans
- Film Clips:
  - OTIS initialization, GEOSAT assimilation
  - Model calibration
  - MSFM initialization
  - Mid-Atlantic Bight initialization

System Attributes

Flexible, portable system

- Robust software supported on various hardware platforms; workstations - supercomputers
- Uniform data representation
- Adaptable to regional physics and available data
- Efficiently set up for arbitrary ocean regions
- Exercised in several real-time shipboard operations

Versatile, modular components

- Facilitates configuration for specific needs
- Existing modules allow choice of physics, statistics, analyses, bio-chem dynamics and acoustic propagation
- Allows replacement of modules and extension of system via different modules
- Facilitates adaptation to new applications and interfacing to other systems

Accurate and efficient:

- Validated in GS, IFF, JGOFS, AthenA, EMed
- Verified in GS, IFF
- Timely delivery of nowcasts and forecasts at sea

Ocean Prediction Systems

Nowcasts, forecasts, data-driven simulations for the physical-biological-acoustical ocean

Multiscales - shipboard, coastal, regional, basin, etc.

Coupled interdisciplinary models and observational network system with data assimilation for prediction and monitoring

Observational system simulation experiment (OSSE)

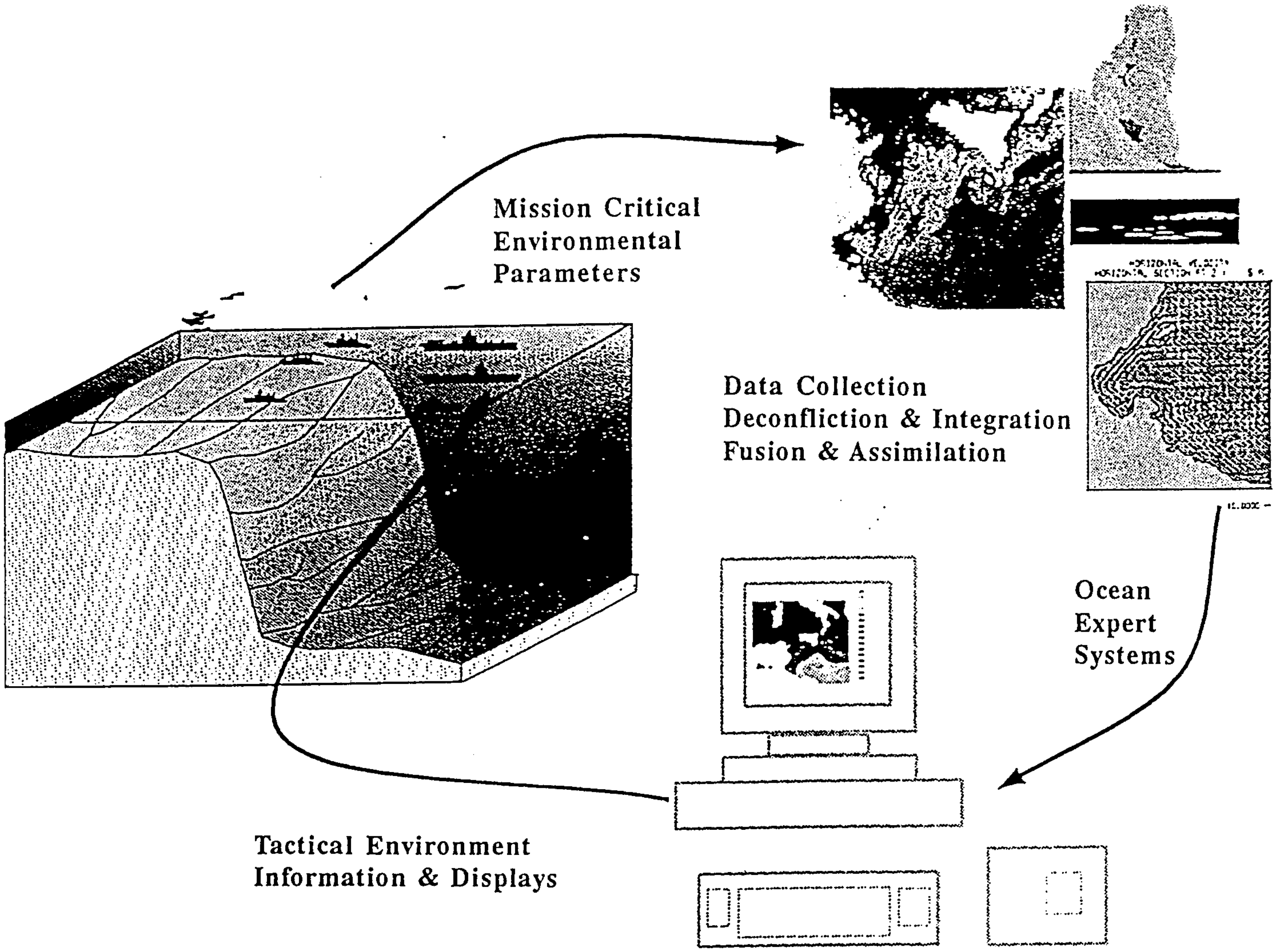
Naval and marine operations

Resource exploration, exploitation and management

EEZ management and pollution control

Biogeochemical cycle, ecosystem and climate dynamics research

Coastal Scene Description Project Demonstrations



Wednesday, October 26
1030
NRL Conference Room
Building 1005 Room A32

Coastal Scene Description Demonstration
26 October 1994

1030 Welcome

Portia J. Harris
NRL
Ocean Prediction and Dynamics Branch

1040 Demonstration Overview

Dr. George W. Heburn
NRL
Ocean Prediction and Dynamics Branch

1050 Demonstrations

Ocean Expert System

David J. Scheerer
Johns Hopkins University/Applied Physics Laboratory

Shore-zone Resolution System

John L. Breckenridge
NRL
Mapping, Charting and Geodesy

1130 Lunch

1230 FY 95 Focus

1300 Action Items

Upcoming Events

MABPOM
3-4 November 94
Rutgers University

VII. Proposed Mini-Workshop Meeting Schedule

26 October 94	NRL/SSC
26 January 95	APL/UW
26 April 95	Harvard University
26 July 95	JHU/APL

MEMO

To: CSD Team Members
Subj: CSD MiniWorkshop Notes
Date: 22 DEC 94

1. The October 94 MiniWorkshop convened at NRL-SSC in conjunction with the Harvard Ocean Prediction System (HOPS) and CSD Demonstraions. Enclosure 1 lists the attendees.

2. Dr. Alan Robinson and Mr. Wayne Leslie gave the HOPS Demo and Mr. Mike Crowley gave a Data Analysis, Feature Model and Data Fusion presentation.

3. The FY 95 focus is a NRL-SSC on-site capability that integrates all efforts on a single platform. The objective is to host an AMW proof-of-concept simulation demonstration in the MAB/LWTC or an analogous high Navy interest area. In order to achieve this objective, well defined hardware, software, and interface requirements must be forwarded to NRL-SSC for on-site system configuration. Timelines and major events that impact the FY 95 efforts are shown below.

9 JAN - 20 JAN	System Configuration Review
23 JAN - 24 FEB	CSD Data/Software Acquisitions
9 JAN - 10 MAR	Hardware/Software Procurement
10 MAR - 31 MAR	System Installation and Checkout
3 APR - 14 APR	CSD Data/Software Rehost
17 APR - 8 MAY	Amphibious Warfare Simulation Development
15 MAY - 16 MAY	CSD Review/Amphibious Warfare Demonstration

Dr. George Heburn addressed core and other budget issues.

4. Discussion of needs and issues that impact the FY 95 efforts were numerous.

NEEDS

Common Interface Definition
OODBM Structure - DSI Conformance
Environmental Characterization
- Upwelling (Oceanographic precursor to Fog)
- Fog (Atmospheric, Amphibious driver)
- Landing Collisions (Fog, Visibility)
- Surf Conditions (Wind, Weather, Open Ocean, Waves, Longshore Currents)

ISSUES

High probability of Fog occurrence useful to Mission Planner
How are Fog conditions handled in Op Planning
Entry against a Rip Tide
Air Space Control, Amphibious Assault Scenarios & Simulations
Distributed Info for Project Integration, Aerial Photos, Coastal Bathymetry, SDV Position, Climatology Variations, High Resolution Spatial and Temporal Scales Data Sources

5. System integration and data resource investigations will be on-going with specific action items reports at the next meeting. Keith Kerr will provide hardware info and Portia Harris will provide sources and make contacts for Landsat and Remote Sensing data from aircraft for Atlantic City, NJ, Tuckerton, NJ, Duck, NC, and the Onslow Bay area.

6. APL/UW will host the next meeting.

Attendees

NAME/EMAIL/PHONE

Arango, Hernan	arango@pacific.harvard.edu	(617) 495-3457
Breckenridge, John	jbreck@dittohd.nrlssc.navy.mil	(601) 688-5224
Crowley, Michael	crowley@caribbean.rutgers.edu	(908) 932-6555 X543
Glenn, Scott	glenn@caribbean.rutgers.edu	(908) 932-6555 X544
Harris, Portia	harris@nrlssc.navy.mil	(601) 688-5787
Heburn, George	heburn@nrlssc.navy.mil	(601) 688-5448
Kerr, Keith	keith.apl.washington.edu	(206) 543-1268
Leslie, Wayne	leslie@pacific.harvard.edu	(617) 495-4569
Lozano, Carlos	lozano@pacific.harvard.edu	(617) 495-9807
Mack, Stephen	steve_mack@jhuapl.edu	(301) 953-6478
Miyamoto, Robert	rtm@apl.washington.edu	(206) 543-1303
Peloquin, Robert	ONR	(703) 696-6462
Robinson, Alan	robinson@pacific.harvard.edu	(617) 495-5192
Scheerer, David	djs@jhuapl.edu	(301) 953-6000 X8754

Enclosure (1)

APPENDIX E

SITE VISITS

1) LITTORAL WARFARE TRAINING CENTER
   CAMP LeJUENE

2) MARINE CORPS MODELING AND SIMULATION
   WORKING GROUP
   QUANTICO, VA

COASTAL SCENE DESCRIPTION MINI-WORKSHOP TRIP REPORT

Coastal Scene Description (CSD) Mini-Workshop participants met at Camp Lejuene 15-16 June 1994. Briefs, tours, specific project discussions, and Littoral Warfare Training Complex (LWTC) development issues addressed Mini-Workshop objectives to better understand and influence LWTC developments through information interchange among academic, government, and private sector researchers. The agenda and roster are in Enclosures (1) and (2) respectively.

The Command Brief emphasized the need for a facility that provides a platform to verify and validate operations using datum and models to simulate littoral environments. Land management, forestry, fish and wildlife briefs stressed the importance of natural history resources in the area. A walking tour of Upper New River Riparian Sanctuary on Paradise Point provided observations of many vegetation and riverine features. Periodic Capability Exercises demonstrate the facility's diversity and similarities to littoral environments. LWTC coastline features enable mission planners and mission analysts to generate operational scenarios that evaluate training objectives, system performance, and operational effectiveness.

The vision brief given by Jeff O'Byrne highlighted the LWTC objectives and operational training requirements shown in Enclosure (3). Middle Atlantic Region features and processes include Area Military Complexes, Urban Target Com-

plexes and beach suitable for seaborne and helo-borne assaults that are representative of combat environments and littoral operational areas.

George Heburn gave the CSD Project overview and discussed the Middle Atlantic Bight (MAB) as the specific area of interest for OES, TEIS, SHORES, and DA&F Projects. Edwin Danford, Maria Kalcic, and John Breckenridge addressed data standards and the availability of high resolution digital data. George Kerr addressed the roles of TOWAN and TOSL and need for additional datum. (See Enclosure (4))

Weather station personnel at MCAS New River gave an impressive demonstration of their worldwide forecasting capability and offered to support MAB data collection and deploy a buoy station in support of Janice Boyd's XMOOR and other CSD project efforts.

The Mini-Workshop addressed the need for alliance among mission developers, mission planners, and mission users (civilian and military components). Communications (letting the right hand know what the left hand is doing) and product integration during initial development phases is necessary to achieve a desirable measure of effectiveness and measure of performance that is second to none. Increased knowledge and understanding of oceanographic, atmospheric, and topographic variability in littoral environments can be better understood using LWTC resources to simulate/construct mock operations and achieve a high probability of REAL-time mission success.

NRLLWTC4
14 Jun 94

WELCOME to CAMP LEJEUNE!

On behalf of Brigadier General Livingston we, Lieutenant Wetmore, Gunnery Sergeant Wochna, and Jeff O'Byrne would like to welcome you to Camp Lejeune. We will be responsible for your safety and comfort during your visit. If you have any questions or problems when we are not with you, we can be reached at 910-451-5747. In addition, Jeff can be reached at home, 910-455-3828. We will be happy to do whatever is necessary to make your visit a stressless success.

We encourage you to wear casual clothes with walking shoes. We won't do much walking, but it won't be on sidewalks. You encouraged to bring binoculars and cameras.

The schedule as currently established is:

Date	Time	Event	Responsible	Location
14 Jun				
		Pickup by MCB vehicle at A.J.Ellis Airport for transport to Hampton Inn or Paradise Point BOQ		
15 Jun				
	0700	Breakfast		Hampton Inn, Shoney's(across the street) or the Officer's Club.
	0730	Depart for Camp Lejeune		Hampton Inn
	0800	Welcome aboard		Officer's Club(Eagle's Nest)
	0815	Command Brief		Officer's Club
	0900	Natural history brief	Peter Black Carmen Lombardo	Officer's Club
	1130	Lunch		Officer's Club
	1230	Walking tour of Paradise Pt	Peter Black Carmen Lombardo	Upper New River Riparian sanctuary
	1430	LWTC Vision Brief	Jeff O'Byrne	Officer's Club
	1500	Committee matters	Portia Harris	Officer's Club

Enclosure (1)

16 Jun

0700	Check out of motel	Hampton Inn
	Put luggage in bus	
0715	Depart Hampton Inn	
0745	Arrive Paradise Point BOQ	
	Put luggage in bus.	
0730	Depart for tour of Camp Lejeune littoral areas. (Lunch will be in a commercial establishment somewhere along the road.)	
1530	Arrive at airport, (we'll adjust to meet schedules).	

Jeff

JEFF O'BYRNE

Coastal Scene Description Mini-Workshop - Littoral Warfare Training Center
Camp Lejuene - Jacksonville, NC - 15-16 June 1994

NAME/EMAIL	ORGANIZATION	PHONE
Boyd, Janice boyd@nrlssc.navy.mil	NRL	(601) 688-5251
Breckenridge jbreck@dittohd.nrlssc.navy.mil	NRL	(601) 688-5224
Danford, Edwin	DMA	(703) 285-9326
Dantzler, Lee dantzhl1@.jhuapl.edu	JHU/APL	(301) 953-5387
Glenn, Scott glenn@caribbean.rutgers.edu	RUTGERS	(908) 932-6555 X544
Harris, Portia harris@nrlssc.navy.mil	NRL	(601) 688-5787
Heburn, George heburn@lexington.nrlssc.navy.mil	NRL	(601) 688-5448
Kalcic, Maria kalcic@nrlssc.navy.mil	NRL	(601) 688-4436
Kerr, George kerr@nrlssc.navy.mil	NRL	(601) 688-4627
Kerr, Keith keith@anchor.apl.washington.edu	APL/UW	(206) 543-1268
Mack, Stephen steve_mack@jhuapl.edu	JHU/APL	(301) 953-6478
Miyamoto, Robert rtm@apl.washington.edu	APL/UW	(206) 543-1303
Robinson, Allan robinson@pacific.harvard.edu	HARVARD	(617) 495-2819
Scheerer, David dsj@stdc.jhuapl.edu	JHU/APL	(301) 953-6908
Styles, Richard styles@arctic.rutgers.edu	RUTGERS	(908) 932-6555 X543

Enclosure (2)

Coastal Scene Description Mini-Workshop - Littoral Warfare Training Center
Camp Lejuene - Jacksonville, NC - 15-16 June 1994

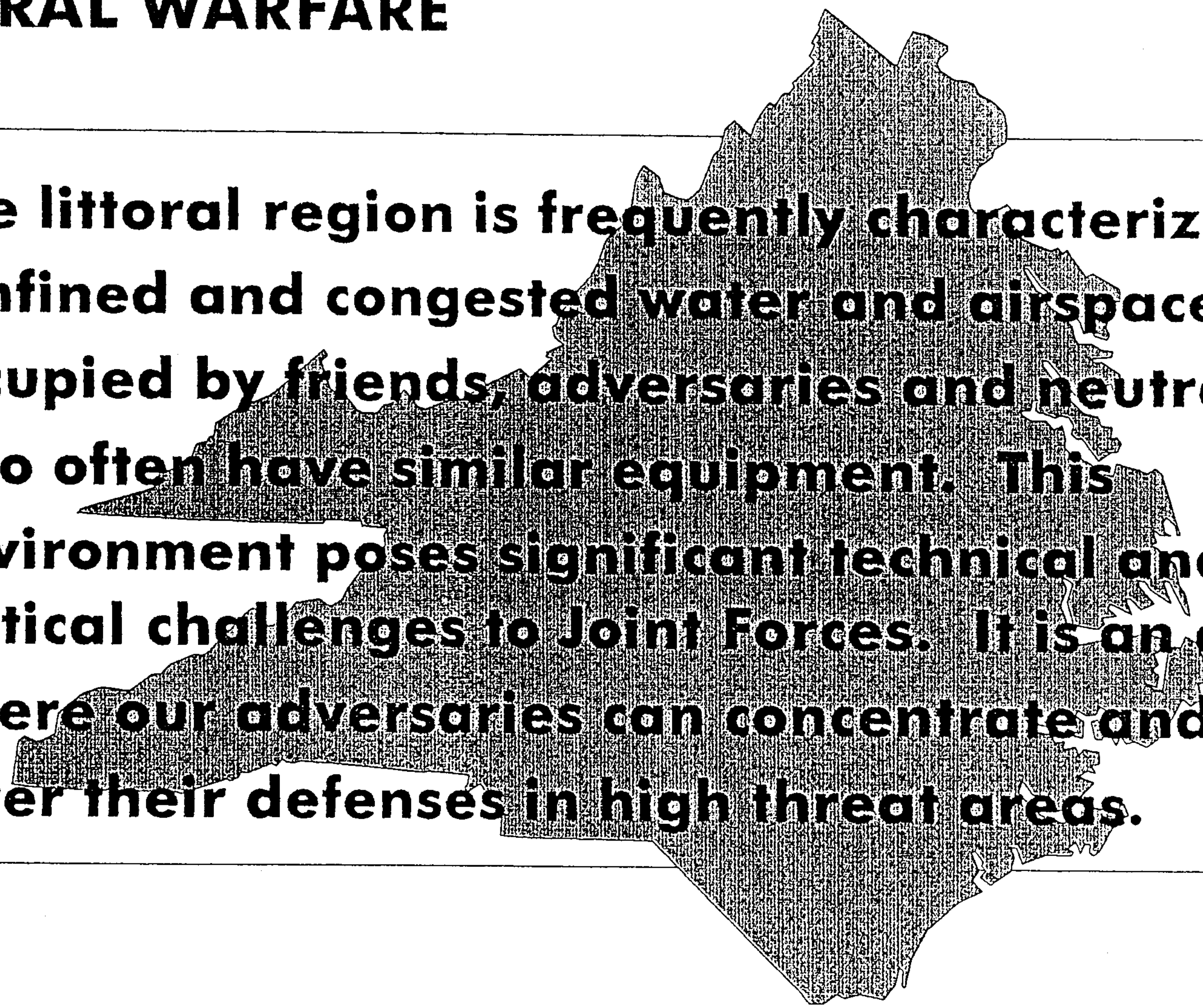
NAME	ORGANIZATION	PHONE
LtCol M. J. Swords Director, Training Resources Management Division (TRMD)	Camp Lejuene	(910) 451-5747
Jeff O'Byrne TRMD	Camp Lejuene	(910) 451-5747
1st Lt Kevin Wetmore Operations Division	Camp Lejuene	(910) 451-5276
GySgt Brian Wochna TRMD	Camp Lejuene	(910) 451-5747
Carmen Lombardo Fish & Wildlife Division	Camp Lejuene	(910) 451-2195
Peter Black LUMS & Forestry	Camp Lejuene	(910) 451-5063
Mary Lynn Phillips GIS Manager	Camp Lejuene	(910) 451-5876


A VISION FOR A
LITTORAL
WARFARE TRAINING COMPLEX
Quantico
Fort Bragg

Enclosure (3)

LITTORAL WARFARE TRAINING COMPLEX

LITTORAL WARFARE



The littoral region is frequently characterized by (confined and congested water and airspace) occupied by friends, adversaries and neutrals who often have similar equipment. This environment poses significant technical and tactical challenges to Joint Forces. It is an area where our adversaries can concentrate and layer their defenses in high threat areas.

LITTORAL WARFARE TRAINING COMPLEX

"...From the Sea" Mandates:

- A change to link Naval Warfare to Joint Warfare.
- Training as a cohesive total Joint Force (Sea-Air-Land Team) with the capability to accomplish:

  Command, Control and Surveillance
  Battlespace Dominance
  Power Projection
  Force Sustainment

- A Littoral Warfare Training Complex meets this need and will allow us to "TRAIN AS WE WILL FIGHT."

LITTORAL WARFARE TRAINING COMPLEX

OBJECTIVES

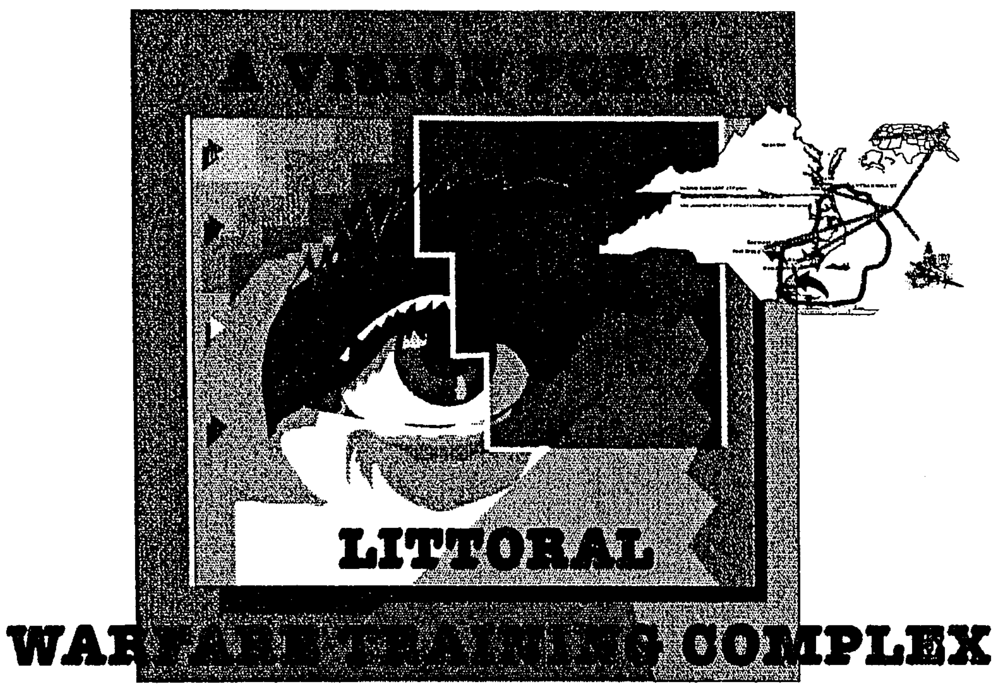
- Provide for Operating Force training requirements and validation of doctrine and plans.
- Allow for total C_4I training at the operational level.
- Allow for force-on-force and multiple threat scenario generation.
- Allow for connectivity and continuity between the training commands and field applications of constructive, virtual and live simulations.
- Provide for autonomous range sector operations capability to meet day to day basic and intermediate training requirements.
- Link existing collocated infrastructures to realize a sophisticated Littoral Warfare combat environment with instrumentation.

LITTORAL WARFARE TRAINING COMPLEX

- What are the complex's present capabilities?
- What capabilities need enhancing?

METHODOLOGY

How Will We Get There?



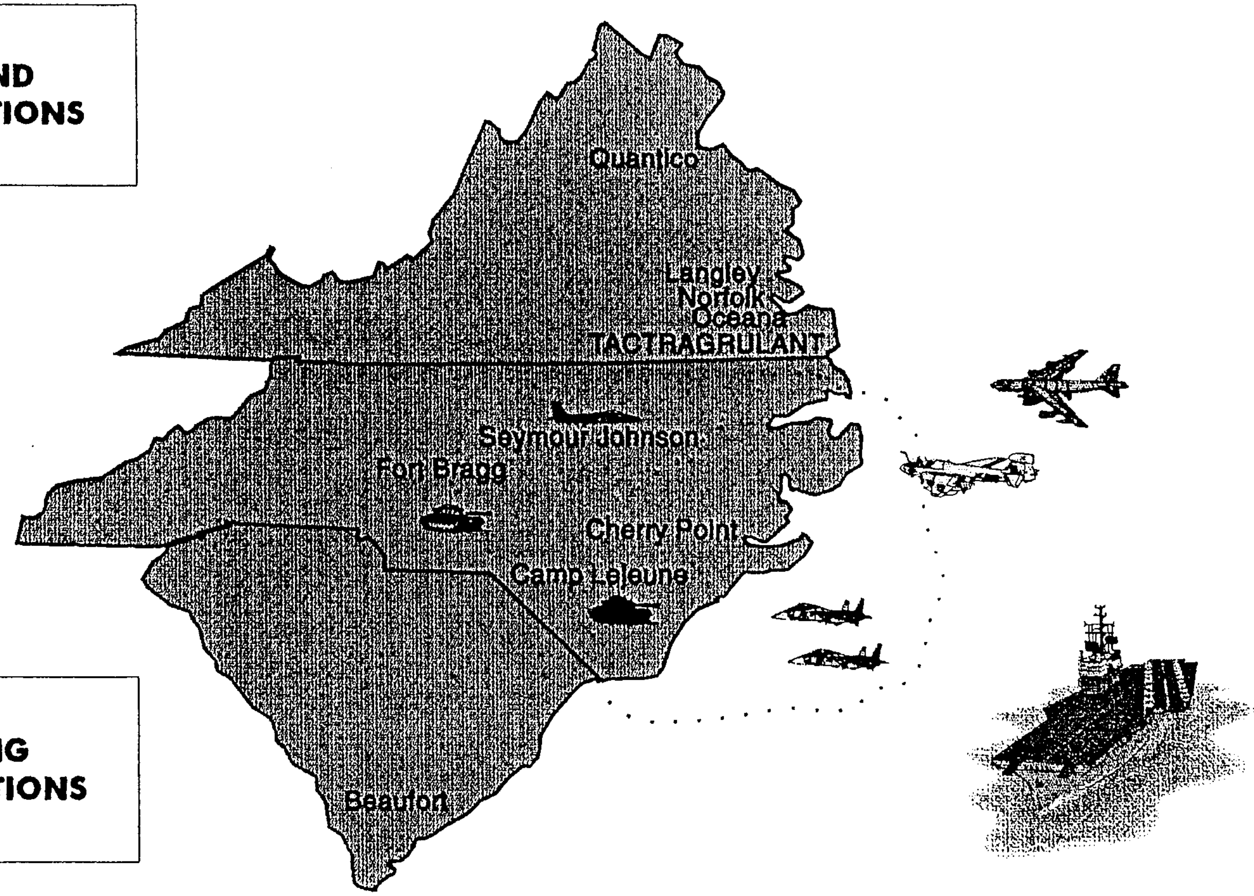
H-1 COMMAND CENTER

LITTORAL WARFARE TRAINING COMPLEX

COMMAND
ORGANIZATIONS

RANGE
AREAS

TRAINING
ORGANIZATIONS



LITTORAL WARFARE TRAINING COMPLEX

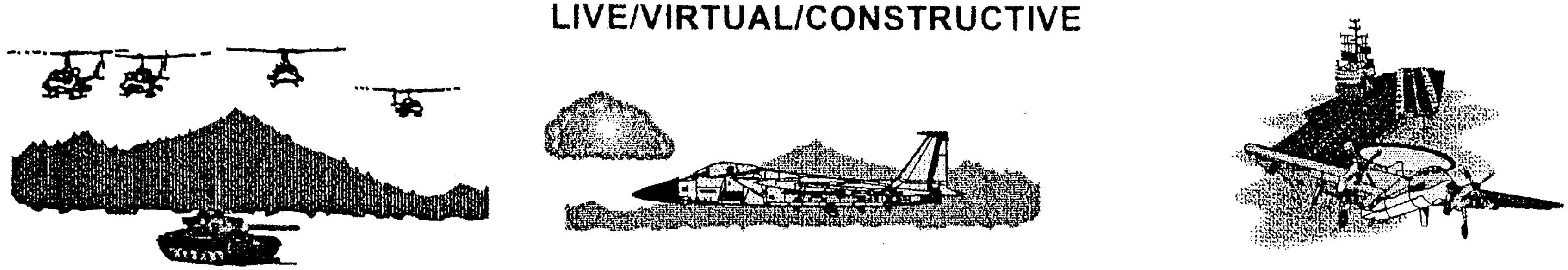
Operating Forces Must:

- Train to fully integrate the Joint Sea-Air-Land team in all functional warfare areas.
- Train to conduct operations from the sea in a littoral environment, mastery of which cannot be presumed.
- Identify and train to the diversified threats and unique tactical challenges that will be encountered in the littoral environment.

LITTORAL WARFARE TRAINING COMPLEX

"Total" Force on Force Capability

LIVE/VIRTUAL/CONSTRUCTIVE



LANDWARD | COASTAL | SEAWARD

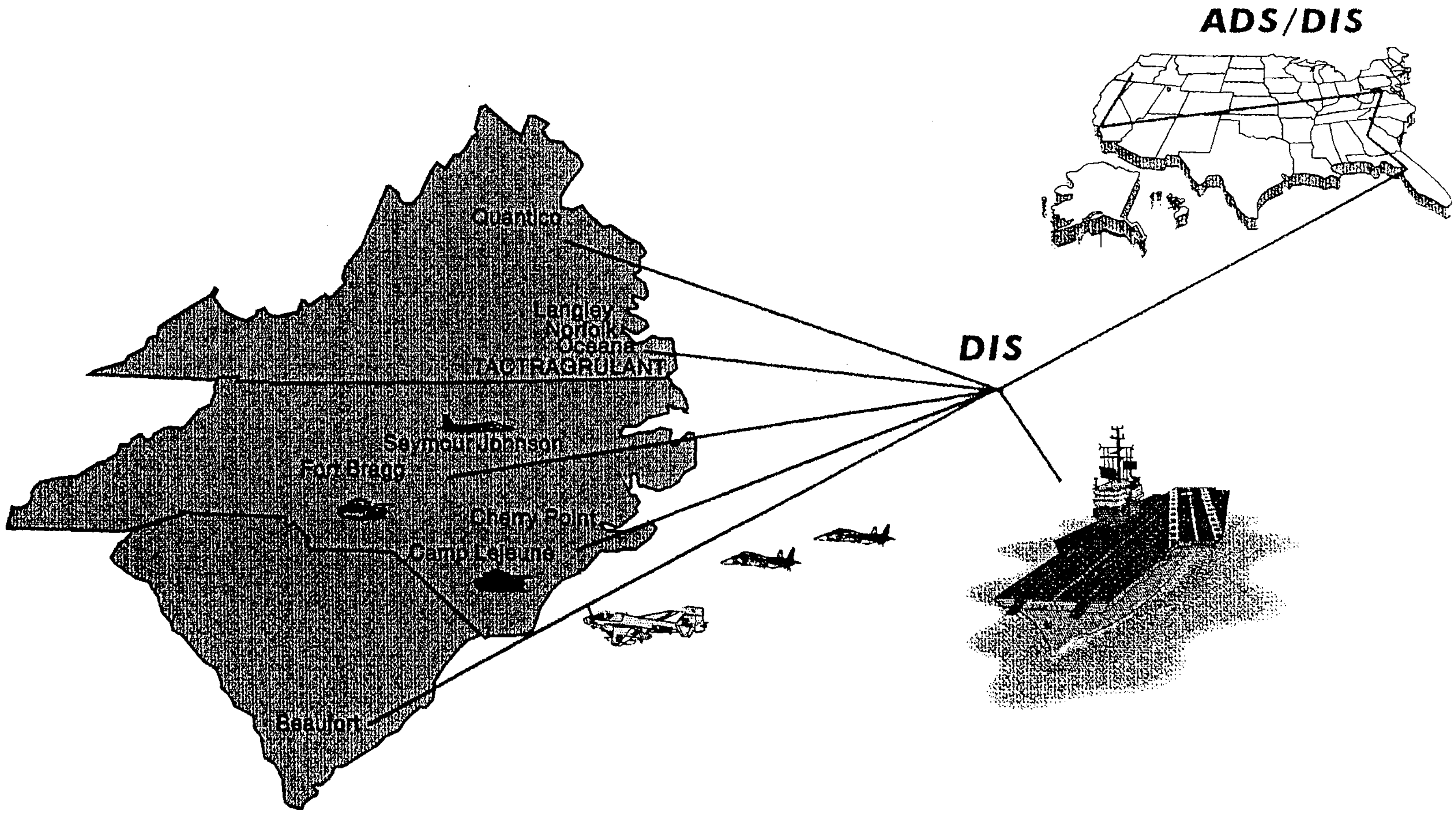
Combined Arms
Integrated Air Defenses/C_4I
Fixed Wing (Strike)
Fixed Wing (Fighter/Interceptor)
Rotary Wing
Ground Forces
(Military, Paramilitary, Terrorist)
Armored Units
Artillery Units
Coastal Antiship Missiles/Artillery
Riverine Units
Special Operations Forces
Mobile Logistics/Support Units
Mine Warfare Units
Signal Intelligence/Electronic Warfare Units

Aircraft Carriers (U.S. Only)
Surface Combatants
Auxillary Ships
Amphibious Ships
- **MAGTF (ACE/GCE)**
- **Support Craft**
- **Support Units**

Submarines
Patrol Combatants
Maritime Patrol Units
Mine Warfare Units
Fixed Wing (land based/sea based)
Rotary Wing
Special Operations Forces

LITTORAL WARFARE TRAINING COMPLEX

Interconnectivity for Total Force Training



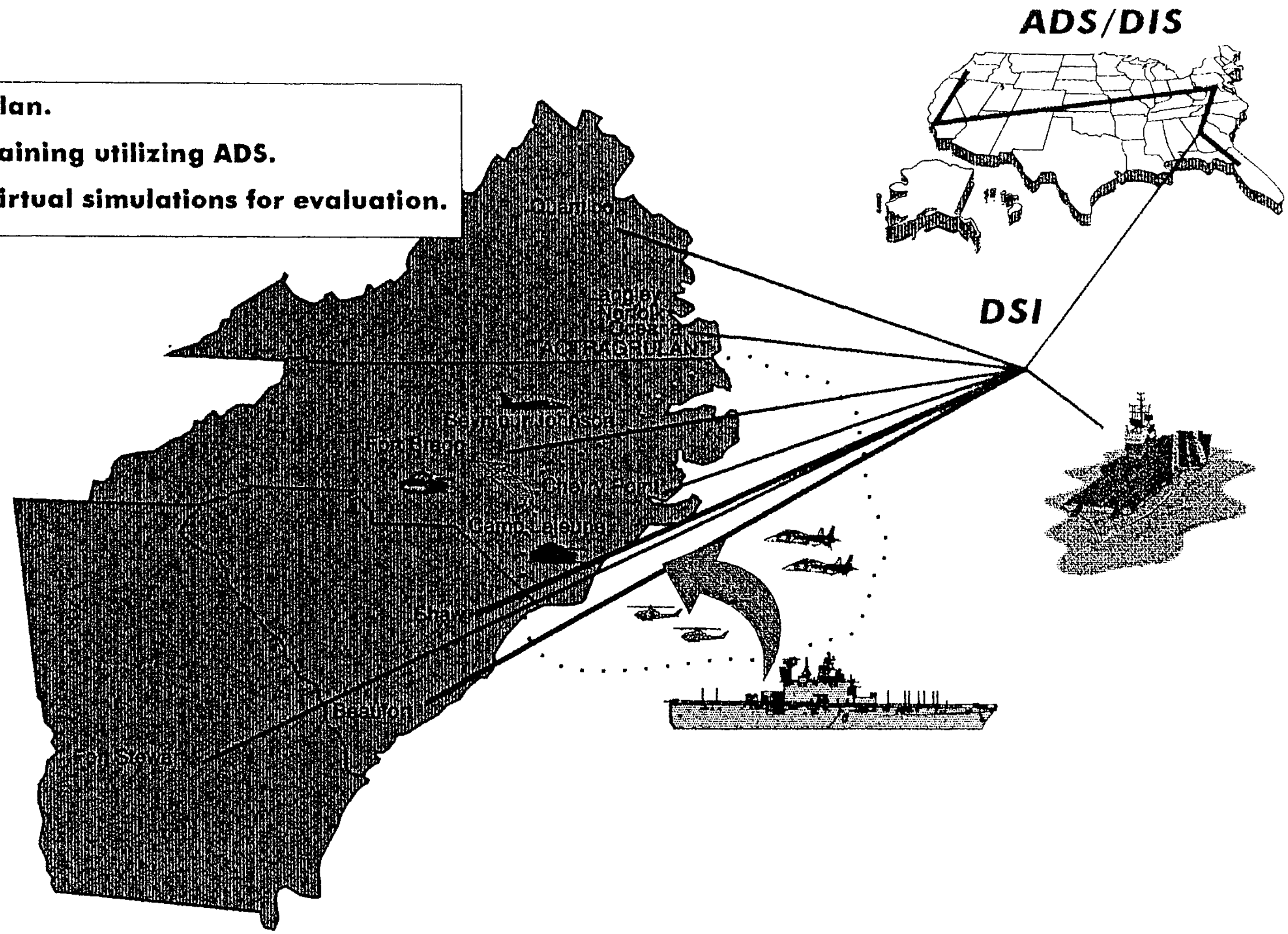
LITTORAL WARFARE TRAINING COMPLEX

Demonstration of Capability

Validate USACOM JTF plan.

Demonstrate Littoral Training utilizing ADS.

Live, constructive and virtual simulations for evaluation.

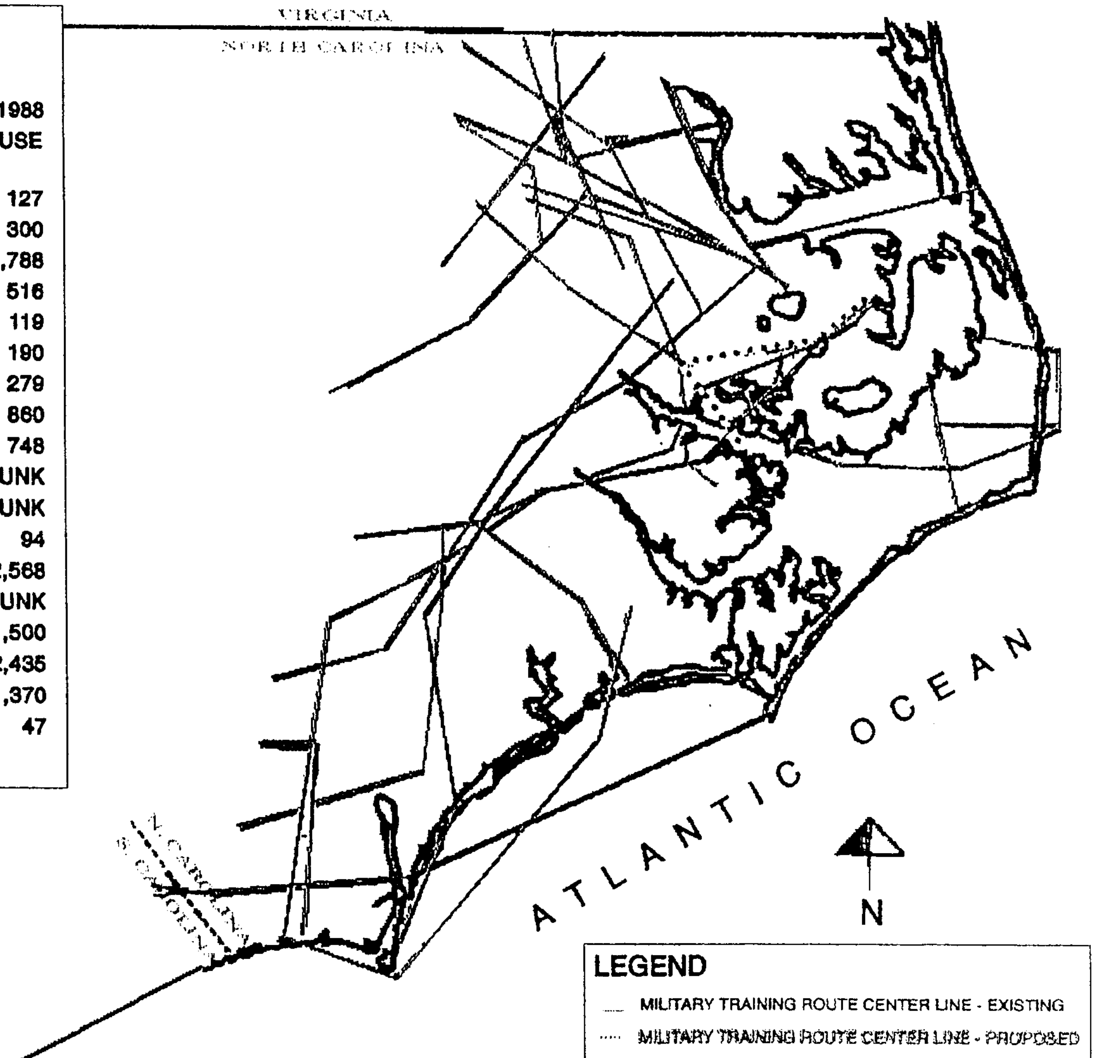


CONTROLLED AIR/LAND/SEA SPACE

MILITARY LOW LEVEL (100-7000 FEET) ROUTES THAT CONNECT TO AREA

MILITARY TRAINING ROUTES WITHIN THE REGION

ROUTE	ORGANIZING AGENCY	BASE ALTITUDE	1988 USE
IR 12	SHAW AFB	500	127
IR 62	NAS OCEANA	3,000	300
VR 73	SEYMOUR JOHNSON AFB	100	1,788
VR 85	SHAW AFB	500	516
IR 718	NAS OCEANA	7,000	119
IR 719	NAS OCEANA	5,000	190
IR 720	NAS OCEANA	7,000	279
VR 1043	MCAS CHERRY POINT	200	860
VR 1046	MCAS CHERRY POINT	200	748
VR 1057	SEYMOUR JOHNSON	100	UNK
VR 1058	SEYMOUR JOHNSON	100	UNK
VR 1069	SC ANG	500	94
VR 1074	SEYMOUR JOHNSON	100	2,568
VR 1713	ANDREWS AFB	100	UNK
VR 1752	NAS OCEANA	500	1,500
VR 1753	NAS OCEANA	500	2,435
VR 1758	NAS OCEANA	200	1,370
VR 1759	NAS OCEANA	500	47



LITTORAL WARFARE TRAINING COMPLEX

The Mid-Atlantic Region is a littoral operational area with regard to combat environment representation to include:

- **Area Military Complexes**
- **Urban Target Complexes**
- **Beachhead Complexes**

LITTORAL WARFARE TRAINING COMPLEX

Summary

- Meets evolving requirements
- Major infrastructure in place
- Strong political support
- Exploits existing and emerging technology
- Low risk - high pay off investment

LITTORAL WARFARE TRAINING COMPLEX

Summary

- Pragmatic and parallel development of inter-range and intra-range subcomponents is crucial
- LWTC concepts will meet new joint force tactical training requirements if implemented
- LWTC investment strategy would:
  - Establish total C_4I training capability
  - Be cost effective
  - Facilitate timely transition
  - Validate Doctrine/Research & Development/Procurement/OPLANS
- LWTC would complement 29 Palms/NTC/Red Flag Complex
- LWTC fully integrates naval strike/amphibious, ground, and air operations across entire spectrum

Tactical Oceanography Program

Coastal Scene Description Project

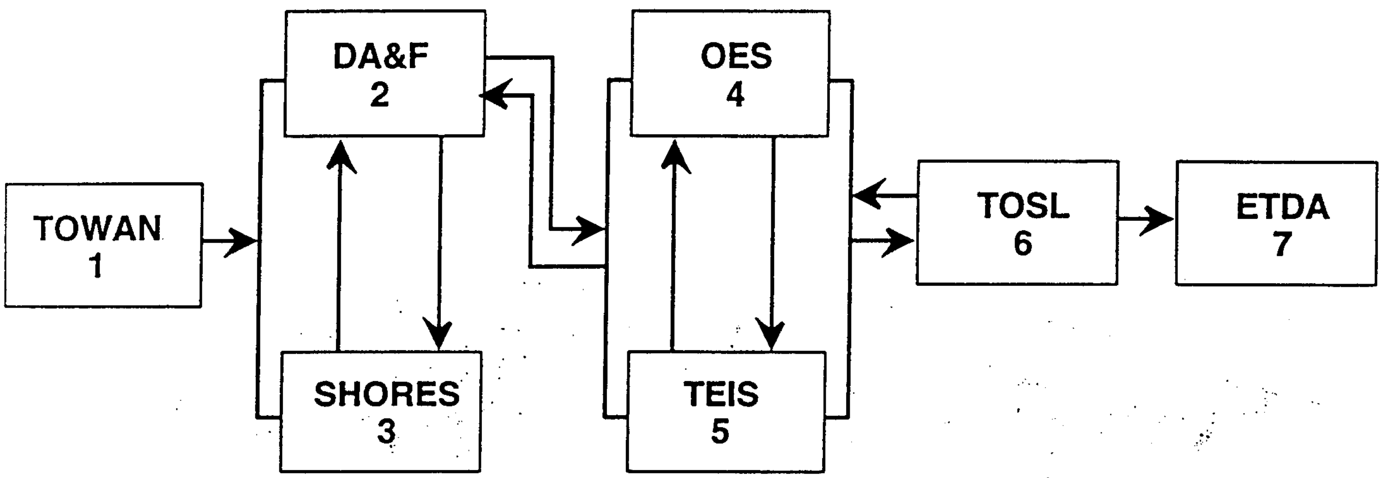


Figure 1. Tactical Oceanography Product Integration Diagram

1. Tactical Oceanography Wide Area Network
2. Data Assimilation & Fusion
3. Shallow-Water Hypsographic Oceanographic Registration and Data Evaluation System
4. Ocean Expert System
5. Tactical Environmental Information System
6. Tactical Oceanography Simulation Laboratory
7. Environmental Tactical Decision Aid

Enclosure (4)

Table of Contents

MCMSWG 20 Oct 94 Agenda

0850 - 0900	Admin Remarks	Lt Dave Farris
0900 - 0930	M&S Mgmt Intro	Col Hanover
0930 - 1030	STOW/LeatherNet	LCDR Feldmann/Capt Bryant
1030 - 1045	Break	
1045 - 1130	LWTC	Jeff O'Byrne
1130 - 1230	Lunch	
1230 - 1300	JMCM ACTD	Mr. Blumenthal/Maj Wysocki
1300 - 1330	MTWS update	Maj Connally
1330 - 1415	JSIMS	CAPT Falkey
1415 - 1430	Break	
1430 - 1500	MAGTF II/LOG issues	Ms. Sheila Finke
1500 - 1530	JWID-95	Maj Terry
1530 - 1550	JTCTS	Maj O'Conner
1550 - 1630	Plenary Session	Col Hanover

The Commandant's Direction . . .

"Before we buy, build or fight . . ."

The M&S Master Plan, together with the Investment Plan, will direct the Corps' M&S technology exploitation in all facets of the combat development/execution process.

Accordingly, ensure your interests are represented in the Plans!

MCMSMO

2

The Universe of M&S . . . .
AGENCIES

- DoD
- DoN
- CINCS
- JCS
- HQMC
- MCAGCC
- FMF

MCMSMO

The Universe of M&S . . . .
SYSTEMS

	Low Tech	Medium Tech	High Tech
Individual	CBT	ISMT	TTES
Tactical	??	??	Leathernet
Campaign	??	MTWS	JSIMS/Leathernet
Acquisition	??	Ad Hoc	JSIMS/Ad Hoc
DSS	MAGTF II/LOG AIS		JSIMS/??

MCMSMO

The Concept-to-Reality Process

- Study the Playing Field
  - what is realistic, available, *affordable*?
- Articulate the Need
  - Fleet Operational or Mission Needs Statement (FONS/MNS)
- Construct a Program Proposal
- Prioritize the Programs for the POM
  - compete in the POM process -- Politics!
- Develop the Product
  - user must participate in alpha and beta testing
- Procure the Product

MCMSMO

The Role of the Working Group

- Get the Requirements on the Table
  - Ensure your commanders are aware of developments
- Assist in the Prioritization Effort
- Participate in the Development Process
  - Development testing takes money and manpower

MCMSMO

Proposed
USMC Involvement
in
STOW-97

MCMSMO Brief to MCMSWG

20 October 1994

Desired Level of MARFOR "Play" in STOW-97

- MEU/ARG in theater
  - Forward presence
  - CLF reports to CATF
- MEU expands to MEF (FWD)
  - COMMARFOR ashore

Desired Level of MARFOR "Play" in STOW-97 (cont)

- Possible scenario. . .
  - NCA deems conflict imminent
  - CJTF assigned
  - MPF movement initiated
  - CG II MEF designated as COMMARFOR
  - MEF (FWD) deploys
  - Absorbs MEU

Desired Level of MARFOR "Play" in STOW-97 (cont)

- Possible scenario. . . (cont)
  - OMFTS capability in theater
  - CJTF commences hostilities
  - MEF (FWD) seizes port and airfield
  - MPF offload
  - AFOE commences buildup
  - MEF established

USMC Participation in STOW-97: MAGTF Elements

- CE - Live
  - JTASC, MCCCF (?)
- ACE - Virtual (ModSAF) and/or Live (instrumented)
  - JTASC (virtual), MCCCF(?) (virtual), Cherry Pt TACTS range (live), MAWTS (live)
- CSSE - Constructive (ALSP Confederation) or Virtual (ModSAF)
  - JTASC, II MEF Wargaming Center
- GCE - Virtual (ModSAF)
  - MCAGCC ADS Demo Site

Marine Corps Modeling and Simulation Management Office

STOW-97 USMC Issues

- MARFORLANT/USACOM Concept of ops??
  - MARFORPAC/MCAGCC
  - 17 Nov - Brief to USACOM
- M&S infrastructure to support participation
  - MCCCF/LWTC
  - MTWS - ALSP link
  - DSI @ CLNC and MAWTS
  - DIS/TACTS range interface @ MAWTS
  - TACTS coverage/integration into AOA chosen
- Littoral environment & amphib ops assets
  - JCOS role?

STOW-97 USMC Issues (cont)

- Coordination with CINCLANTFLT efforts and goals
- Workup, tech demo and FV opportunities for USMC STOW-97 involvement
  - Tier 2 exercises - FLEETEX
  - MSTP Phase 3 CPX
  - CAX

APPENDIX F

PUBLICATIONS AND PRESENTATIONS

FY 94 Publications

JHU/APL

Johns Hopkins APL Technical Digest
Volume 14 Number 2(1993)
"An Expert System For Describing and Predicting the Coastal Ocean Environment"

Johns Hopkins APL Technical Digest
Volume 14 Number 3(1993)
"Reasoning Under Uncertainty for a Coastal Ocean Expert System"

Oceans 1994
"An Expert System for Describing the Coastal Ocean Environment"

Coastal Scene Description Concept Development and Demonstration Test Bed Area
STD-N-989
10 June 1994

APL/UW

The Evolution of the Tactical Environmental Information System Classes
July 1994

HU/DAS

Harvard Open Ocean Model Reports
Reports in Meteorology and Oceanography
Number 50
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Real Time Nowcasting and Forecasting Operational Forecasts and Simulation Experiments At Sea

FY 94 Publications

RU/IMCS

1994 Ocean Sciences Meeting

"Remote Sensing and In-Situ Observations of Coastal Upwelling/Downwelling Offshore of New Jersey"

"Continental Shelf Circulation and Sediment Transport During A Middle Atlantic Bight Northeaster Storm"

NRL/SSC/OD

6th IEEE International Conference On
Tools With Artificial Intelligence

New Orleans, LA
6-9 November 1994
NRL/PP/7320--94-0032

"Intelligent Tools For Environmental Tactical Decisions Aids"

FY 95 Publications

HU/DAS

"A Robust Optimal Interpolation Scheme For Real Data Assimilation in the Harvard Ocean Prediction System"
(In Preparation)

NRL/SSC/MGD

SHORES Research Plan NRL Memorandum Report
(In Preparation)

SHORES Research Findings NRL Report
(In Preparation)

NRL/SSC/OD

"Coastal Scene Description: Interim Status Report"

NRL/MR/7322--95-7594

FY 95 Presentations

NOV 94 - Middle Atlantic Bight Physical Oceanography & Meteorology Workshop

Rutgers University
New Brunswick, NJ
3-4 November 1994

"A Summer of Upwelling Observations Offshore New Jersey"
RU/IMCS

"Simulations in the Middle Atlantic Bight: Shelf-break Dynamics and Ring Interactions"
HU/DAS

"Middle Atlantic Bight Significance to the Coastal Scene Description Project"
NRL/SSC/OD

FEB 95 - Mississippi Academy of Sciences

Marine and Atmospheric Sciences Division
Biloxi, MS
9-10 February 1995
NRL/SSC/OD
NRL/PP/7322--95-0077

"Environmental Factors That Influence Amphibious Assault Mission Effectiveness"